Vol. 56 OCTOBER 1980 No. 4

THE PAN-PACIFIC ENTOMOLOGIST

SAN FRANCISCO, CALIFORNIA • 1980

***Published by the* PACIFIC COAST ENTOMOLOGICAL SOCIETY**
***in cooperation with* THE CALIFORNIA ACADEMY OF SCIENCES**

The Pan-Pacific Entomologist

Published quarterly in January, April, July and October with Society Proceedings appearing in the October number. All communications regarding nonreceipt of numbers, requests for sample copies, and financial communications should be addressed to the Treasurer, Dr. Paul H. Arnaud, Jr., California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

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The annual dues, paid in advance, are $12.00 for regular members of the Society, $7.00 for student members, or $15.00 for subscription only. Members of the society receive *The Pan-Pacific Entomologist*. Single copies of recent numbers are $3.75 each or $15.00 a volume. Write to the treasurer for prices of earlier back numbers. Make all checks payable to *The Pacific Coast Entomological Society*.

The Pacific Coast Entomological Society

Statement of Ownership

Title of Publication: The Pan-Pacific Entomologist.

Frequency of Issue: Quarterly (January, April, July, October).

Location of Office of Publication, Business Office of Publisher and Owner: Pacific Coast Entomological Society, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.

Editors: T. D. Eichlin and A. R. Hardy, Insect Taxonomy Laboratory, California Dept. of Food and Agriculture, 1220 N St., Sacramento, California 95814.

Managing Editor and Known Bondholders or other Security Holders: None.

This issue mailed 12 November 1980

Second Class Postage Paid at San Francisco, California and Additional offices.
The Pan-Pacific Entomologist (ISSN 0031-0603)
PRINTED BY THE ALLEN PRESS, INC., LAWRENCE, KANSAS 66044, U.S.A.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 241–259

IDENTIFICATION OF *ELIPSOCUS* SPECIES OF WESTERN NORTH AMERICA WITH DESCRIPTIONS OF TWO NEW SPECIES (PSOCOPTERA: ELIPSOCIDAE)[1]

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This paper presents a taxonomic treatment of the species of *Elipsocus* found from the eastern slopes and outlier hills of the Rocky Mountains west to the Pacific Coast in the United States and in the Canadian province of British Columbia.

The literature reveals only a single named species of *Elipsocus* in this region, *E. occidentalis* Banks. The present study recognizes six species. Four are known European species, three of which are recorded for the first time from North America (*E. hyalinus* (Stephens), *E. pallidus* Jentsch, and *E. westwoodi* McLachlan). The fourth European species, *E. mclachlani* Kimmins is identical with *E. occidentalis,* and its name falls into the synonymy of the latter. The other two species are new to science and are named here and described.

Banks' catalogue (1907b) lists six species of *Elipsocus* for the United States and Canada. Of these, all but two have subsequently been removed—by synonymy, correction of erroneous placement, and restriction of the genus. The remaining two are *E. occidentalis,* here treated, and *E. pumilis* (Hagen), an eastern species not currently recognizable by modern criteria.

The genus *Elipsocus* was set up by Hagen (1866) in one of the earliest attempts at higher classification of psocids following their recognition as a natural group. Since its first use, *Elipsocus* has undergone several restrictions. The usage followed here is that now generally accepted (Badonnel 1943, Roesler 1944), differing only in that female microptery is noted here for the first time in this genus.

Species determination in *Elipsocus* is a difficult task. Reliable characters are few, and the extent of variation of each remains poorly understood. Identification at present relies heavily on minor differences in female external genitalia (male external genitalia apparently offer no useful characters) coupled with color pattern differences in head, forewing, and abdomen. The color pattern characters vary with state of color development at the time of preservation and state of preservation. They are never as obvious in males as in females. Lacinial tip figures generally are included with descriptions, but the actual differences between species in these structures appear to be few.

Several new characters were discovered during this study. The color pattern of the epiproct appears to be diagnostic for females of most species although it shows no differences in males. A row of small setae occurs on the anterior margin of the forewing very near the wing base and is continuous onto the humeral lobe. The number of setae in the row (on the wing proper, excluding those on humeral lobe) appears to be relatively constant, subject to sexual dimorphism, within each species and to differ between species. In no case are my data sufficient to allow statistical analysis, but the numbers (BR of Table 1) are recorded for all individuals observed. The ratio of length of pterostigma (measured from base of stigmasac to distal end of pterostigma on wing margin) to forewing length (measured along longest axis of forewing) appears to be a useful character for some species.

Materials and Methods

The present study is based on examination of 264 adult specimens from the geographic region indicated above. Morphological observations were made on slide preparations in Hoyer's medium under a compound microscope. Color observations were made on whole specimens in alcohol with direct light under a dissecting microscope. Measurements were made with a filar micrometer. The micrometer unit was 0.987 μ. All characters noted above in the discussion of species determination are recorded for all species. All data in the diagnoses of European species are taken from the North American specimens on hand. Abdominal color patterns of the European species were amply illustrated by Jentsch (1938) and Günther (1974). No differences were noted in abdominal color pattern between European and North American representatives of these species, and these patterns are not re-illustrated here.

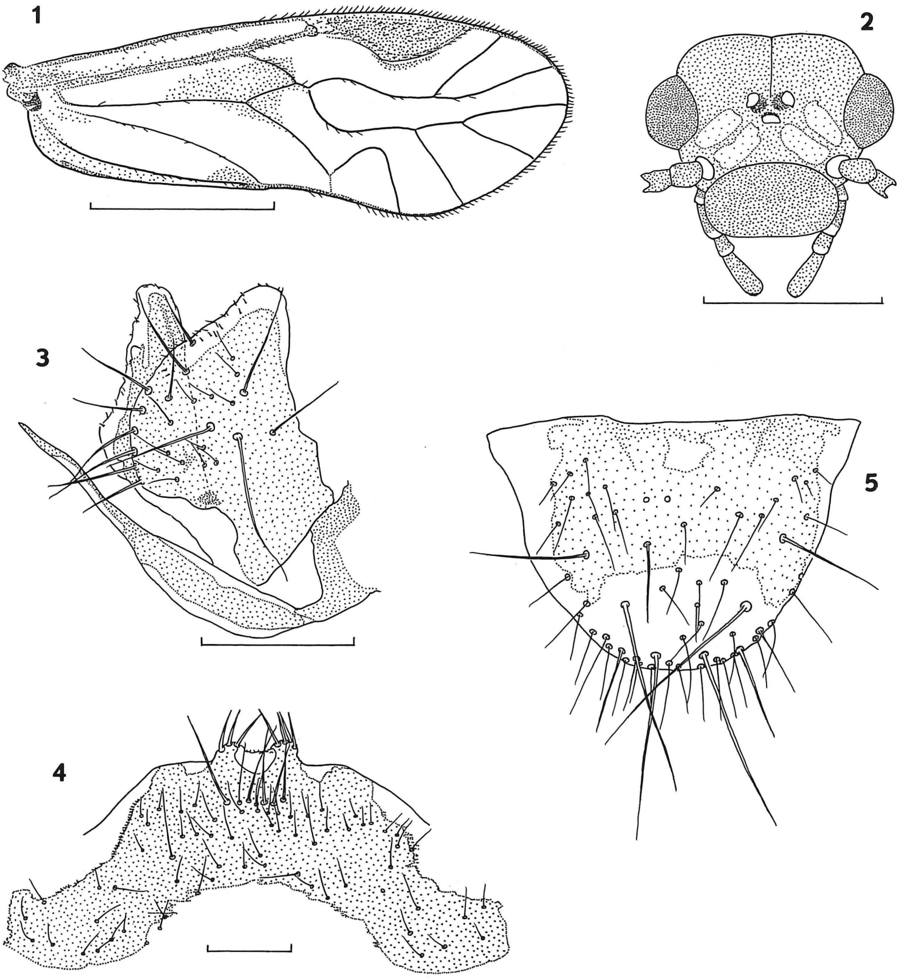
The following abbreviations are used in the measurements (Table 1): FW = forewing; HW = hindwing; F = hind femur; T = hind tibia; t_1, t_2, t_3 = first, second, and third hind tarsomere; cten = ctenidia (comb-based setae) on first hind tarsomere; f_1, f_2, f_3 = first, second, and third flagellomeres; IO/D = least distance between compound eyes divided by greatest antero-posterior eye diameter in dorsal view; PO = transverse diameter of eye divided by greatest antero-posterior diameter of eye in dorsal view; FW/P = forewing length divided by length of pterostigma; BR = row of small setae on anterior margin of forewing at base; M = macropterous; m = micropterous.

Elipsocus hyalinus (Stephens)

Psocus hyalinus Stephens 1836:123. Complete synonymy in Günther 1974:170.

Table 1. Measurements (μ), counts, and ratios for *Elipsocus* species of western United States and British Columbia. Abbreviations are explained in text.

Species + sex	FW	HW	F	T	t_1	t_2	t_3	cten	f_1	f_2	f_3	IO/D	PO	BR	FW/P
guentheri ♂	3855	2861	587	1177	369	69	102	19	514	410	339	1.57	0.70	0	3.17
guentheri ♂	3493	2651	602	1141	348	56	107	20	480	378	324	1.79	0.75	1	3.38
guentheri ♂	3940	2944	671	1247	427	89	123	20	595	456	398	1.63	0.78	0	3.33
guentheri ♀ M	3831	2843	655	1240	341	84	126	13	503	396	300	2.30	0.60	0	3.26
guentheri ♀ m	277	207	521	809	225	63	99	—	245	204	173	2.86	0.54	—	—
guentheri ♀ m	293	203	533	860	242	56	105	—	269	244	200	2.79	0.69	—	—
obscurus ♂	4348	3287	675	1407	368	73	113	19	593	473	399	1.76	0.78	1	3.21
obscurus ♂	4508	3392	676	1421	395	70	120	17	593	458	400	1.01	0.94	3	3.05
obscurus ♀	3849	2935	646	1301	319	76	114	17	563	437	360	2.21	0.65	1	3.42
obscurus ♀	3346	2562	582	1137	287	70	112	17	508	355	314	2.34	0.59	1	3.39
hyalinus ♀	3400	2337	513	1023	296	62	115	18	422	293	216	1.98	0.70	5	3.83
hyalinus ♀	3069	2289	501	1039	292	60	114	17	426	319	246	2.00	0.59	5	3.40
occidentalis ♂	2768	2103	534	974	320	61	106	16	444	317	247	1.34	0.75	5	3.64
occidentalis ♀	2645	2002	505	882	264	59	110	15	325	231	183	2.45	0.59	4	3.56
pallidus ♂	3421	2600	598	1221	381	68	112	21	580	413	341	0.95	0.86	9	3.27
pallidus ♀	3253	2472	574	1137	318	66	112	19	528	343	283	2.25	0.74	8	3.39
westwoodi ♂	3280	2487	602	1166	353	63	125	16	565	428	359	—	—	3	3.47
westwoodi ♂	3080	2305	514	1032	314	63	107	17	475	363	304	0.99	0.78	4	3.50
westwoodi ♀	3161	2421	557	1047	279	69	114	13	452	338	276	2.32	0.67	5	3.80



Figs. 1–5. *Elipsocus hyalinus* (Stephens) ♀. Fig. 1. Forewing. Scale = 1.0 mm. Fig. 2. Head, dorsal view. Scale = 0.5 mm. Fig. 3. Ovipositor valvulae. Scale = 0.1 mm. Fig. 4. Subgenital plate. Scale = 0.1 mm. Fig. 5. Epiproct. Scale of Fig. 3.

Diagnosis.—Only females known throughout most of range. Without wing polymorphism. Head (Fig. 2) dark brown except for two paler spots on each side between ocelli and antennal base. Forewing (Fig. 1): pterostigma darkly pigmented; forewing otherwise marked with a spot before R-M junction and a small spot at nodulus. Abdomen with terga 4–6 dark brown, contrasting with paler terga before and after. Subgenital plate (Fig. 4) with transverse band of setae not as wide as distance between lateral edges of distal lobes. Ovipositor valvulae (Fig. 3): second valvula with a small process on median edge of pigmented area. Epiproct (Fig. 5) deeply pigmented on each side at base, more lightly pigmented throughout rest of basal half, unpigmented over most of distal half. Measurements, counts, and ratios in Table 1.

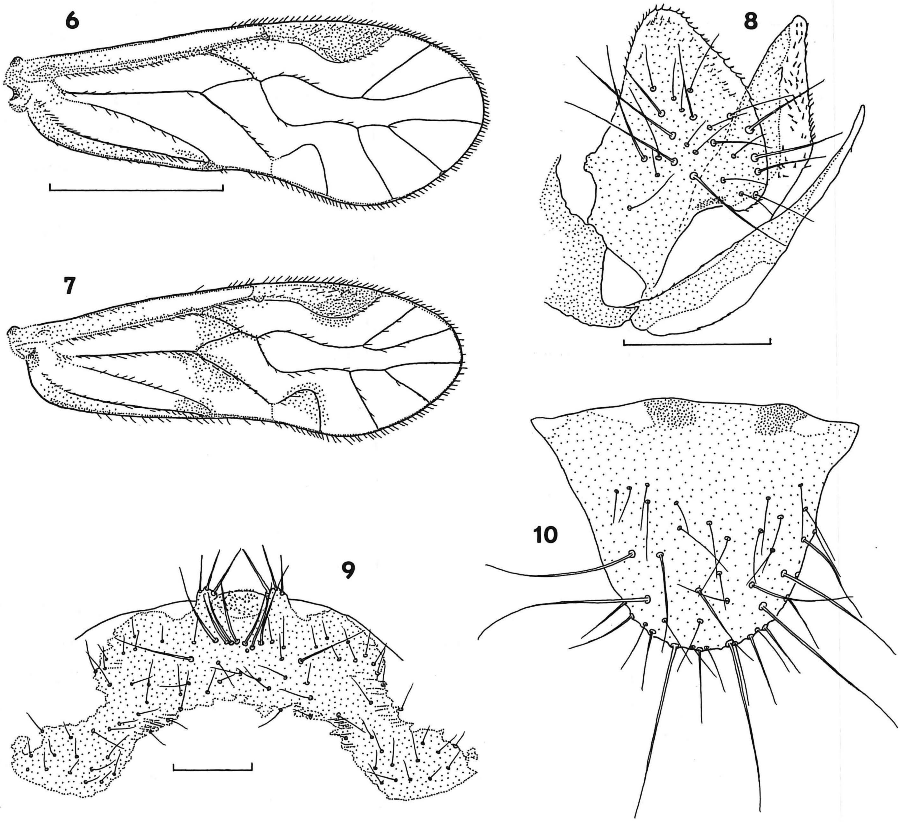
Records.—British Columbia: Vancouver Co.: Vancouver, 15 August 1950, 2 ♀, H. H. and J. A. Ross; 10–26 July 1962, in light trap, 58 ♀, G. G. E. Scudder; 16 July 1963, beating conifers, 1 ♀, R. C. Rounds; Nanaimo Co.: Vancouver Island: Langford, 5 September 1963, light trap, 1 ♀. California: Marin Co.: Mill Valley, early June 1950, caught in cheesecloth trap, 1 ♀, H. B. Leech. Oregon: Coos Co.: Eel Creek State Park, 1 August 1969, beating lodgepole pine (*Pinus contorta* Loudon) in dunes scrub, 2 ♀, E. L. Mockford.

Elipsocus occidentalis Banks

Elipsocus occidentalis Banks 1907a:166.
Elipsocus mclachlani Kimmins 1941:528, **NEW SYNONYMY**. See also synonymy of *E. mclachlani* in Kimmins (1941).

Diagnosis.—Known from both sexes. Without wing polymorphism. Head marked as in *E. westwoodi* (Fig. 20 and diagnosis of that species). Forewing (Figs. 6, 7): pterostigma pale in basal half, remainder dark; forewing otherwise marked with brown border of first segment of Rs, first segment of M, first segment of Cu_1 from its base to slightly beyond half its length, Cu_{1a} except at its base and tip, a brown spot before nodulus, and another in cell IA near its base. Abdomen with terga yellowish white except some females with a narrow transverse spot of brown on each of terga 6–8. Subgenital plate (Fig. 9) with transverse band of setae relatively narrow, not as wide as distance between lateral edges of distal lobes; transverse band flanked by two large setae somewhat anterior to the band. Ovipositor valvulae (Fig. 8): second valvula with a minute, pointed process on median edge of pigmented area. Epiproct (Fig. 10) with a deeply pigmented area on each side of midline at base, an irregular unpigmented area to each side of heavy pigmentation of base, remainder lightly pigmented. Measurements, counts, and ratios in Table 1.

Records.—British Columbia: Nanaimo Co.: Vancouver Island: Victoria, 3 ♂ (paratypes), 1 ♀ (lectotype, #11466, Museum of Comparative Zoology), Dr. Bergroth; Vancouver Co.: Vancouver: Surrey, 10 July 1946, 1 ♂, 2 ♀, H. H. Ross; Vancouver: Brockton Point, 15 July 1946, 1 ♂, 8 ♀, H. H. Ross. Oregon: Lane Co.: Armitage State Park, 28 June 1963, beating western red cedar (*Thuja plicata* Donn), Douglas fir (*Pseudotsuga taxifolia* Britton), and broad-leaved trees, 2 ♂, 18 ♀, E. L. Mockford and F. Hill. Washington: Pierce Co.: 14 km east of Olympia on U.S. Highway 99, 28 June



Figs. 6–10. *Elipsocus occidentalis* (Banks). Fig. 6. ♂, forewing. Scale = 1.0 mm. Fig. 7. ♀, forewing. Scale of Fig. 6. Fig. 8. ♀, ovipositor valvulae. Scale = 0.1 mm. Fig. 9. ♀, subgenital plate. Scale = 0.1 mm. Fig. 10. ♀, epiproct. Scale of Fig. 8.

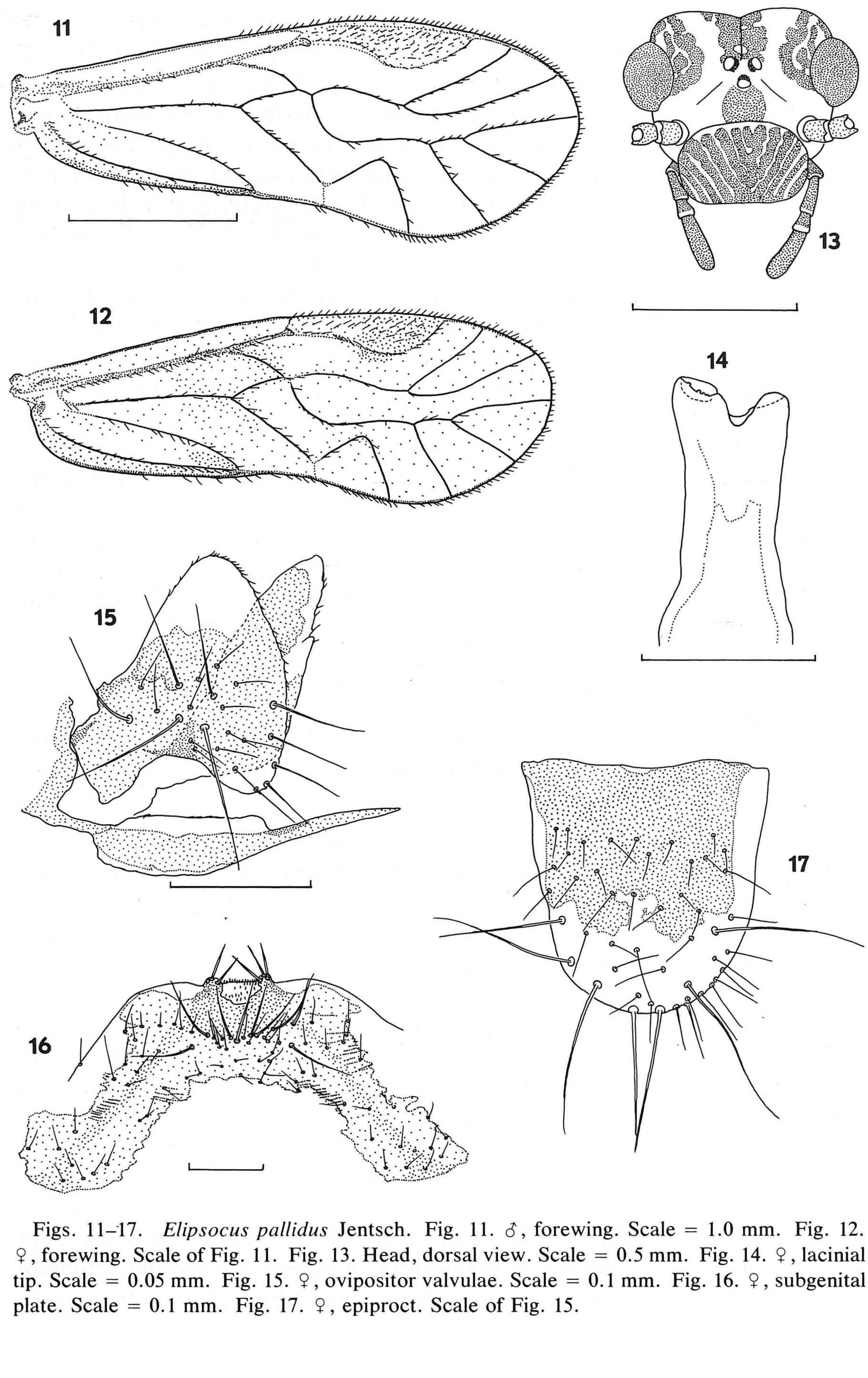
1963, on maple trunks (*Acer* sp.) and beating maples and alders (*Alnus* sp.), 15 ♂, 10 ♀, 1 nymph, E. L. Mockford and F. Hill.

Note.—Although the name *E. occidentalis* has not been used except in catalogues since it was first coined, it cannot be suppressed according to the present International Rules in favor of the name *E. mclachlani,* as the latter name has not been in use long enough (anonymous 1974).

Elipsocus pallidus Jentsch

Elipsocus pallidus Jentsch 1938:27.

Diagnosis.—Known from both sexes. Without wing polymorphism. Head (Fig. 13) creamy yellow with band of brown spotting along median ecdysial



Figs. 11–17. *Elipsocus pallidus* Jentsch. Fig. 11. ♂, forewing. Scale = 1.0 mm. Fig. 12. ♀, forewing. Scale of Fig. 11. Fig. 13. Head, dorsal view. Scale = 0.5 mm. Fig. 14. ♀, lacinial tip. Scale = 0.05 mm. Fig. 15. ♀, ovipositor valvulae. Scale = 0.1 mm. Fig. 16. ♀, subgenital plate. Scale = 0.1 mm. Fig. 17. ♀, epiproct. Scale of Fig. 15.

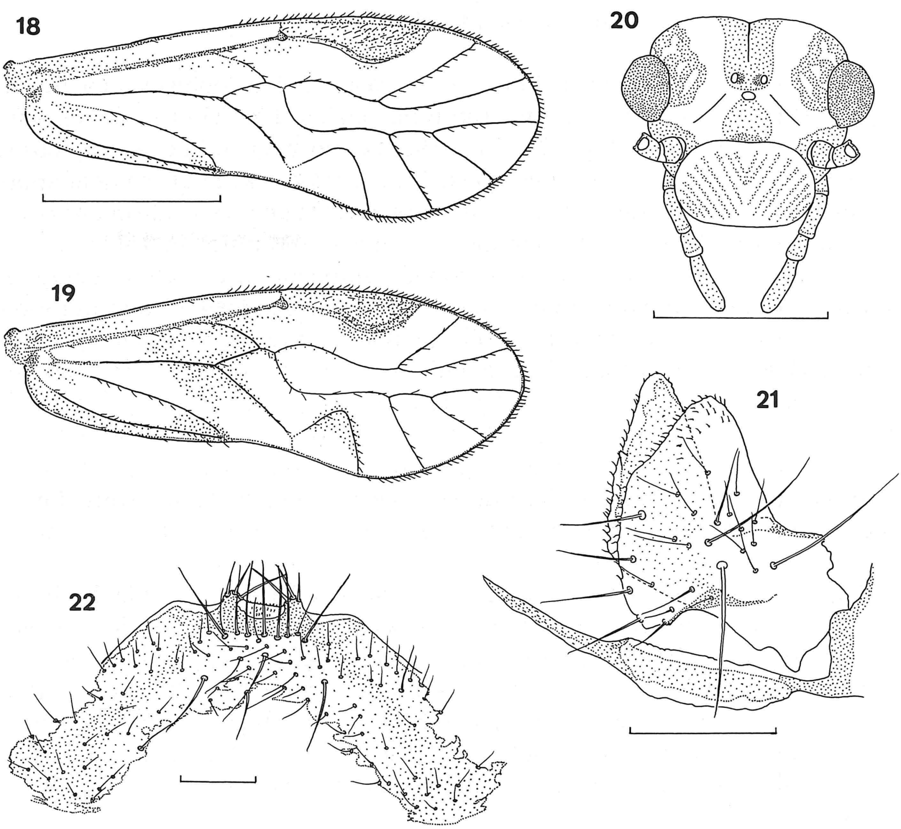
line and bordering each compound eye medially; brown spot on frons before median ocellus; broad brown chevrons on postclypeus. Lacinial tip (Fig. 14) with one or more minute denticles. Forewing (Figs. 11, 12): pterostigma slightly pigmented distally or along its posterior margin; forewing otherwise washed over its entire surface with yellowish brown (more pronounced in female than in male) and with discernibly deeper clouding along M-Cu in its distal third, first segment of Rs, first segment of M, and Cu_1 in its basal half; a small brown spot before nodulus. Abdominal terga uniformly medium reddish brown dorsally, becoming creamy yellow on sides in all segments but last 3–4. Subgenital plate (Fig. 16) with broad transverse band of setae, exceeding in width the distance between lateral edges of distal lobes. Ovipositor valvulae (Fig. 15): second valvula with a rounded process on median margin. Epiproct (Fig. 17) lightly pigmented except unpigmented on sides in basal two-thirds and over entire distal third. Measurements, counts, and ratios in Table 1.

Records.—British Columbia: Vancouver Co.: Vancouver, 17 July 1963, beating pines (*Pinus* sp.), 1 ♀, R. C. Rounds; 6 August 1963, on Scotch broom (*Cytisus scoparius* [Linnaeus] Link), 2 ♂, G. G. E. Scudder; 9 August 1963, on Scotch broom, 1 ♂, R. C. Rounds; 12 August 1963, beating Douglas fir, 1 ♀, R. C. Rounds; Vancouver: Brockton Point, 15 July 1946, 1 ♀, H. H. Ross.

Elipsocus westwoodi McLachlan

Elipsocus westwoodi McLachlan 1867:274. Complete synonymy in Smithers (1967:80) except *E. moebiusi* Tetens regarded as distinct species by Günther (1974).

Diagnosis.—Known from both sexes. Without wing polymorphism. Head (Fig. 20) creamy yellow marked with medium brown: a band along median ecdysial line, a spot in front of median ocellus becoming darker along clypeal border, a field of coalescing spots bordering each compound eye medially, a band from compound eye through antennal base to clypeus on each side, narrow chevron marks on clypeus. Forewing (Figs. 18, 19): pterostigma lightly pigmented basally, moderately pigmented in distal one-half to two-thirds. Male forewing not otherwise marked except for a faint pigment spot before nodulus and faint pigmentation in some basal cells and along veins R and R_1. Well-colored females with a large cloudy brown spot covering distal half of cell R, middle third of cell Cu_{1b}, distal fourth of cell Cu_2, and extending into cells R_1 and M_3; another spot of same color broadly bordering vein Cu_{1a} except at its base. Abdominal terga dark purplish brown dorsally on terga 3–6, creamy yellow on sides; terga 1–2, 7–8 creamy yellow except for purplish brown band of varying width along dorsal midline; clunium (fused terga 9–10) reddish brown. Subgenital plate (Fig. 22) with transverse



Figs. 18–22. *Elipsocus westwoodi* McLachlan. Fig. 18. ♂, forewing. Scale = 1.0 mm. Fig. 19. ♀, forewing. Scale of Fig. 18. Fig. 20. ♀, head, dorsal view. Scale = 0.5 mm. Fig. 21. ♀, ovipositor valvulae. Scale = 0.1 mm. Fig. 22. ♀, subgenital plate. Scale = 0.1 mm.

band of setae about equal in width to distance between lateral margins of distal lobes; the band subtended by three long setae in addition to smaller ones. Ovipositor valvulae (Fig. 21): second valvula with a small spinulose process on edge of pigmented area. Epiproct with two broad pigmented bands extending from base to distal two-thirds, there ending on margin; leaving unpigmented the distal third, a broad median band, and a narrow band on each lateral margin (as in Fig. 35 of *E. obscurus* n. sp.). Measurements, counts, and ratios in Table 1.

Records.—British Columbia: Vancouver Co.: Vancouver, 1 July 1963, beating cedars, 1 ♂, 1 ♀, beating maples, 3 ♂, 3 ♀, R. C. Rounds; 17 July 1963, beating pines, 1 ♂, 2 ♀, R. C. Rounds; 9 August 1963, on Scotch broom, 1 ♂, R. C. Rounds.

Elipsocus guentheri, new species

Diagnosis.—Known from both sexes. Wing polymorphism well developed. Most populations with macropterous males (Fig. 23 of forewing) and micropterous females (Figs. 25, 26 of thorax and wings), but macropterous females also known. Forewings (Figs. 23, 24) totally without pigment spots or bands outside of slight pigmentation of pterostigma in macropterous individuals of both sexes. Measurements, counts, and ratios in Table 1.

Male.—Morphology.—Median cranial ecdysial line well developed, reaching ocellar interval; frontal ecdysial lines faint. Ocellar interval prominent, the pigmented cups of ocelli meeting in middle. Lacinial tip as in female (Fig. 27). Antennae about length of body, about two-thirds length of forewing. Forewing (Fig. 23) with pterostigma long and shallow; stem of Rs fork only slightly curved anteriorly beyond its origin; position of origin of Rs fork variable in relation to origin of M_3; cubital loop long and low, approximately one and one-third times longer than high. Male external genitalic structures typical for the genus (phallosome as in Fig. 36 of *E. obscurus* n. sp. ♂).

Color (in alcohol).—Compound eyes and ocellar interval black. Head medium reddish brown with paler (yellow) spot mediad of each antennal base on frons bordering clypeus. Antennae and legs medium reddish brown; thorax of same color but paler (creamy yellow) on poorly sclerotized areas. Forewings as described in diagnosis (above); hindwings unmarked. Abdomen creamy yellow with broad transverse bands of dark reddish brown subcuticular pigment interrupted on dorsal midline on terga 2–7, continuous on terga 8–10.

Macropterous female.—Morphology.—Head ecdysial lines as described for male; ocellar interval less prominent, the pigment cups not quite meeting in middle. Lacinial tip as in micropterous morph (Fig. 27). Antennal length relative to forewing and body as described for male. Forewing features as described for male except origin of Rs fork slightly distal to origin of M_3. Terminal abdominal structures as in micropterous morph.

Color (in alcohol).—As described for male, but well colored individuals with head with a pale reddish yellow band from ocellar interval diagonally through each parietal area, nearly reaching posterior margin of vertex (Fig. 28). Some individuals with head uniformly pale reddish yellow. Well colored specimens with transverse bands of reddish brown subcuticular pigment on abdominal sterna 3–6, the bands faint along ventral midline, more intense laterally.

Micropterous female.—Morphology.—Aspects related to microptery.—Of normal facies for a micropterous psocid. Compound eyes relatively small (see IO/D figures, Table 1). Ocelli represented by dark pigment spots on some specimens, pigment spots each with a minute cornea on others. An-

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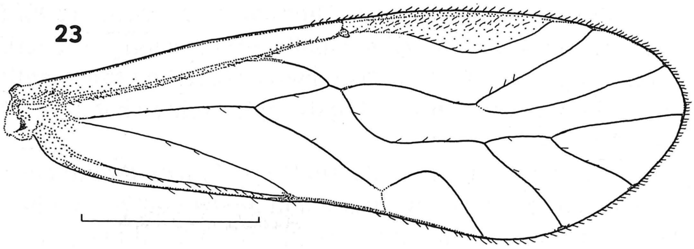

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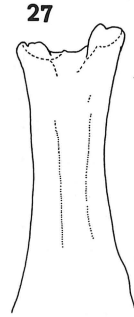

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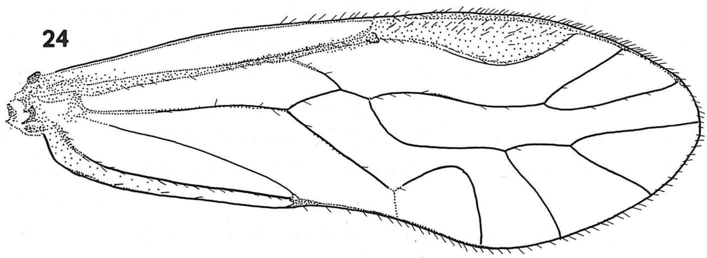

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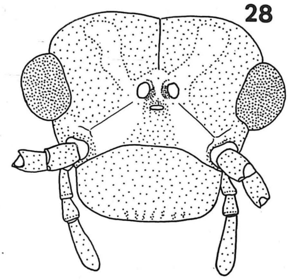

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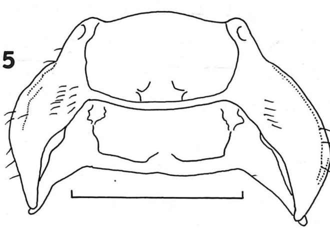

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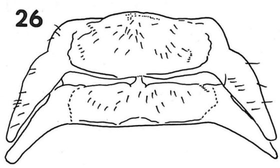

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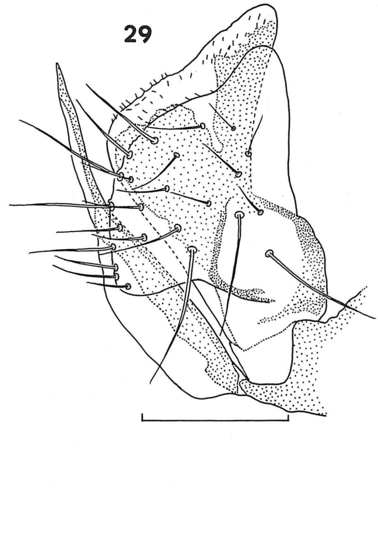

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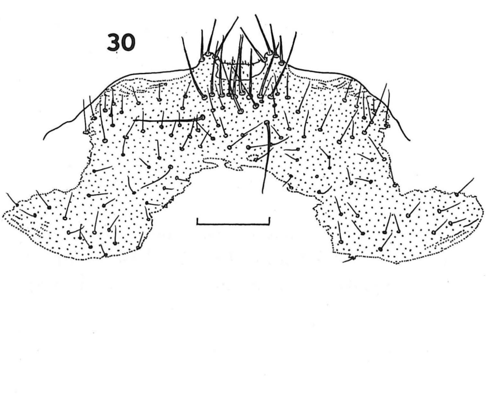

tennae one-half to two-thirds length of body. Thoracic terga virtually flat, without indication of notal lobes. Forewinglet usually about as long as length of meso- and metathorax together, in a few specimens exceeding this length by about length of first abdominal segment. Hindwinglet somewhat shorter than forewinglet (Figs. 25, 26).

Aspects not related to microptery.—Lacinial tip (Fig. 27) with lateral cusp high and bilobed, a small denticle between lateral and median cusps; median cusp lower, with slight indication of marginal lobing. Subgenital plate (Fig. 30) with transverse band of setae slightly less wide than space between lateral edges of distal lobes; the band subtended by two long setae. Ovipositor valvulae (Fig. 29): second valvula lacking process; pigmented area of second valvula with deep cleft in middle; third valvula decidedly narrowed before apex. Epiproct (Fig. 34) with pigmentation in two wide bands, each slightly more than one-third width of epiproct at its base, extending from base about two-thirds length of epiproct and leaving the margin unpigmented except at and near base.

Color (in alcohol).—In general similar to male and macropterous female, differing in following particulars: Head with broad creamy yellow areas (with slight reddish tinge) producing pattern approximately same as that of *E. pallidus* (Fig. 13). Abdomen medium reddish brown dorsally on segments 2–7 except for narrow creamy yellow intersegmental lines; ventrally paler reddish brown, the color absent along ventral midline. Terga 8–10 dark reddish brown.

Holotype.—Micropterous female, allotype male, 13 male and 8 micropterous female paratypes and 6 nymphs, Wyoming: Teton Co.: U.S. Highway 89, 8.1 km south of Yellowstone National Park southern boundary, el. 2103 m, 8 August 1969, beating lodgepole pine, E. L. Mockford. The types are in my collection. A pair of paratypes will be deposited in the Florida State Collection of Arthropods, Gainesville.

Records.—British Columbia: Cariboo Co.: east end of Tacheeda Lake, 27 July 1963, beating spruces (*Picea* sp.), 5 ♂, 3 macropterous ♀, 3 micropterous ♀, 28 nymphs, R. C. Rounds; west end of Tacheeda Lake, 27 July 1963, beating spruces, 4 ♂, R. C. Rounds; Prince Rupert Co.: 13.8 km west of Endako, Highway 16, 31 July 1963, on spruce, 1 ♂, 4 macropterous

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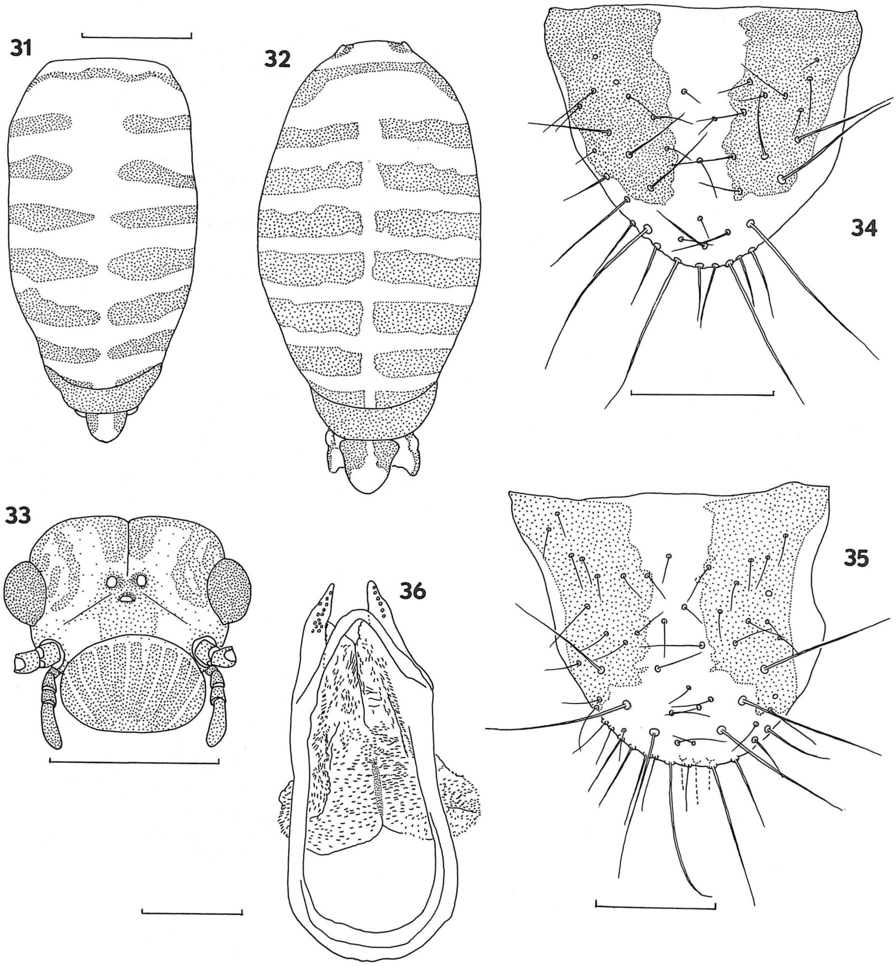
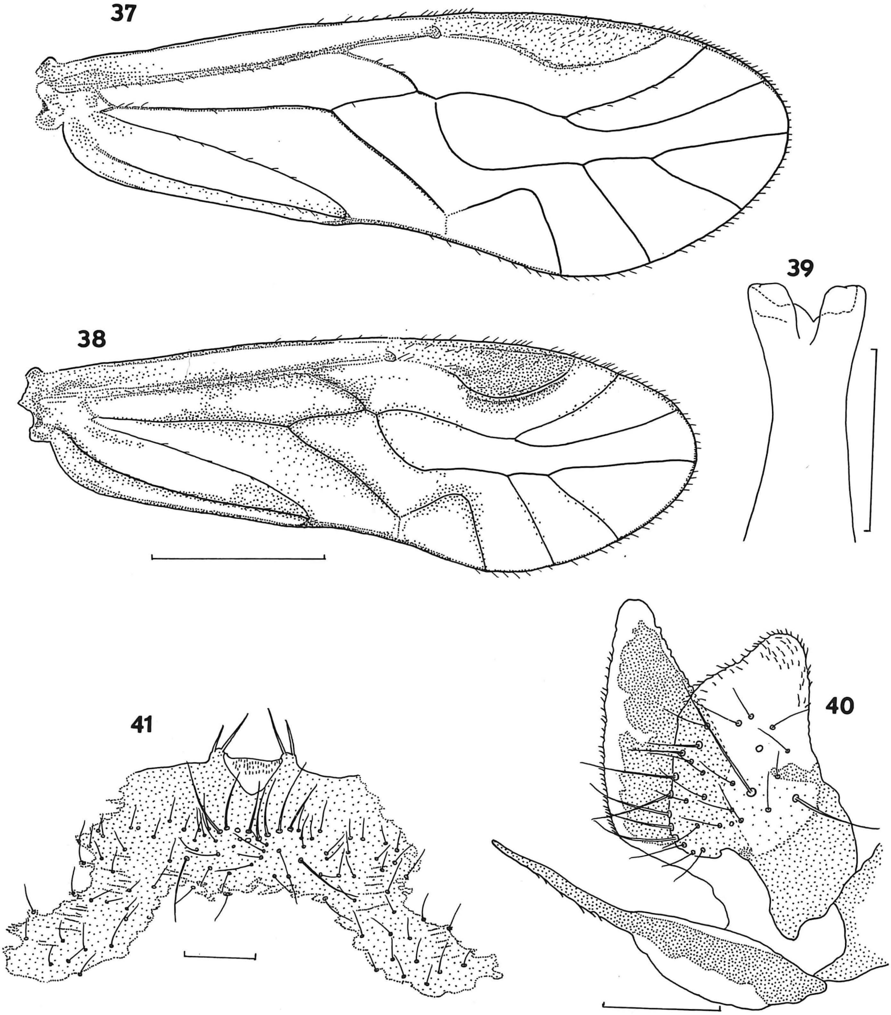
←

Figs. 23–30. *Elipsocus guentheri* n. sp. Fig. 23. ♂, forewing. Scale = 1.0 mm. Fig. 24. Macropterous ♀, forewing. Scale of Fig. 23. Fig. 25. Micropterous ♀, pterothorax, dorsal view. Scale = 0.5 mm. Fig. 26. Micropterous ♀ (shorter-winged form), pterothorax, dorsal view. Scale of Fig. 25. Fig. 27. ♀, lacinial tip. Scale = 0.05 mm. Fig. 28. Macropterous ♀, head, dorsal view. Scale of Fig. 25. Fig. 29. ♀, ovipositor valvulae. Scale = 0.1 mm. Fig. 30. ♀, subgenital plate. Scale = 0.1 mm.



Figs. 31–36. *Elipsocus guentheri* n. sp. and *E. obscurus* n. sp. Fig. 31. *E. guentheri*, macropterous ♀, abdomen, dorsal view. Scale = 0.5 mm. Fig. 32. *E. obscurus* ♀, abdomen, dorsal view. Scale of Fig. 31. Fig. 33. *E. obscurus* ♀, head, dorsal view. Scale = 0.15 mm. Fig. 34. *E. guentheri* ♀, epiproct. Scale = 0.1 mm. Fig. 35. *E. obscurus* ♀, epiproct. Scale = 0.1 mm. Fig. 36. *E. obscurus* ♂, phallosome. Scale = 0.1 mm.

♀, R. C. Rounds; 8.1 km north of Owen Lake, 31 July 1963, beating spruce, 2 ♂, R. C. Rounds. Arizona: Cococino Co.: Grand Canyon National Park: north rim near Kaibab Lodge, el. 2134 m, August 1956, beating dead pine branches, 4 micropterous ♀, R. B. Root. Colorado: Gunnison Co.: Highway 135, 24.1 km north of Almont, 22 July 1969, beating Engelmann spruce (*Picea engelmannii*: [Parry] Engelmann), 1 nymph, E. L. Mockford. Mon-



Figs. 37–41. *Elipsocus obscurus* n. sp. Fig. 37. ♂, forewing. Scale of Fig. 38. Fig. 38. ♀, forewing. Scale = 1.0 mm. Fig. 39. ♀, lacinial tip. Scale = 0.05 mm. Fig. 40. ♀, ovipositor valvulae. Scale = 0.1 mm. Fig. 41. ♀, subgenital plate. Scale = 0.1 mm.

tana: Flathead Co.: Glacier National Park: Virginia Falls, 20 August 1966, beating dead, lichen covered branches of fir (*Abies* sp.), 4 ♂, 3 micropterous ♀, 1 nymph. E. L. Mockford. North Dakota: Burke Co., 11 September 1962, beating dead aspen (*Populus* sp.), 2 micropterous ♀, R. L. Post and R. D. Gordon; Montraill Co., 11 September 1963, beating dead aspen branches, 1 micropterous ♀, R. L. Post and R. D. Gordon. Wyoming: Fremont Co.: Wind River Ranch, 27.4 km west of Dubois, Highway 26, 4 August 1966, beating pine and spruce, 4 ♂, 3 micropterous ♀, 4 nymphs, E. L. Mockford; Tetons Co.: Grand Teton National Park, Highway 36, 22.5 km north of Jackson, 5 August 1966, beating Douglas firs, 2 ♂, E. L. Mockford; Yellowstone National Park, 6 August 1947, 1 micropterous ♀, H. H. and J. A. Ross.

Note.—The only known macropterous females are from the northern end of the known range of the species, in central British Columbia. This is apparently the only known case of microptery in *Elipsocus*.

This species is named for Dr. Kurt K. Günther of the Museum für Naturkunde, Berlin, D.D.R., whose excellent work on Psocoptera in the series "Die Tierwelt Deutschlands" (Günther 1974) ably brought together the information on European *Elipsocus* and all other central European psocid genera.

Elipsocus obscurus, new species

Diagnosis.—Known from both sexes. Without wing polymorphism. Forewings (Figs. 37, 38) with markings variable: male with pterostigma pale brown to deep brown, cell IA colorless to pale brown, wing otherwise unmarked; female with pterostigma medium brown to dark brown; veins in basal half of wing, except Cu_2, brown bordered, likewise Cu_{1a}. Measurements, ratios, and counts in Table 1.

Male.—Morphology.—Median cranial ecdysial line distinct to ocellar interval; frontal ecdysial lines absent or extremely faint. Ocellar interval prominent. Antenna slightly longer than body, about two-thirds length of forewing. Forewing (Fig. 37) as described for *E. guentheri* (above). Male external genitalic structures typical for the genus (Fig. 36 of phallosome).

Color (in alcohol).—Compound eyes black. Head dark chestnut brown with a yellowish brown spot medial to each antennal base on frons bordering clypeus. Antennae deep chestnut brown; legs medium brown. Thorax deep chestnut brown on heavily sclerotized areas, pale reddish brown to white on membranous areas and in a spot in middle of mesonotum and metanotum. Forewings as described in diagnosis (above). Hindwings colorless. Abdomen ringed with broad bands of reddish brown subcuticular pigment on preclunial segments, the bands broadly interrupted on ventral midline; creamy yellow where banding absent; clunium and hypandrium medium chestnut brown.

Female.—Morphology.—Median and frontal ecdysial lines distinct. Ocellar interval smaller, less prominent than in male. Antenna about three-fourths length of body, two-thirds length of forewing. Lacinial tip (Fig. 39) with relatively high, slightly bilobed lateral cusp, lower median cusp, and rounded denticle between but closer to lateral cusp. Forewing (Fig. 38) with pterostigma relatively shorter than in male, cell Cu_{1a} slightly shorter, about as long as high. Subgenital plate (Fig. 41) with transverse band of setae slightly less wide than space between lateral edges of distal lobes; the band subtended by two long setae. Ovipositor valvulae (Fig. 40): second valvula lacking process; pigmented area of this valvula with moderate cleft in middle; third valvula with apex slightly narrowed. Epiproct (Fig. 35) with pigmentation in two wide bands, each slightly more than a third width of epiproct at its base, extending parallel most of length of epiproct from base nearly to tip, ending on margin near tip but leaving lateral margins unpigmented from base to near tip.

Color (in alcohol).—Generally as in male, differing in following features. Head (Fig. 33) with distinct pattern of dark and pale areas, the pale areas white or creamy yellow, the white restricted to a spot mesad of each antennal base on frons bordering clypeus; dark areas of head medium to dark chestnut brown, distributed as a band along median ecdysial line almost to ocellar interval, a spot including ocellar interval and extending forward to clypeus, a field of spots bordering each compound eye medially, a narrow ring around each antennal base connected to eye by a narrow band, clypeus except for narrow pale lines separating the darker areas into chevrons; frontal ecdysial lines bordered with reddish brown. Forewings as described in diagnosis. Hindwings unmarked.

Holotype female, allotype male, 10 male and 8 female paratypes and 10 nymphs, California: Riverside Co.: 9 km south of Sage on Highway 3, 14 March 1979, beating sumac (*Rhus* sp.), jojoba (*Simmondsia chinensis* Link), and other chaparral shrubs, E. L. Mockford and J. D. Pinto. The types are in my collection. A pair of paratypes will be deposited in the Florida State Collection of Arthropods, Gainesville.

Additional paratypes.—Type locality, 18 March–21 April 1976, beating jojoba, 6 ♂, 12 ♀, collector not indicated; 8 April 1978, beating jojoba, 1 ♂, collector not indicated. These paratypes will be deposited in the collection of the Entomology Department, University of California, Riverside.

Other records.—California: Mendocino Co.: Hopland, 7 April 1970, swept from grass, 1 ♀, A. G. Forbes; Riverside Co.: Dripping Springs Camp Ground, Cleveland National Forest, 14 March 1979, beating sage brush (*Artemisia* sp.), live oak, (*Quercus agrifolia* Neé) and sumac, 1 ♂, 2 ♀, 2 nymphs, E. L. Mockford; H. James Reserve near Lake Fulmor, el. ca. 1622 m, 26 May 1973, 1 ♂, J. D. Pinto; Manifee Valley, west end, el. 549 m, 10 March 1979, beating sage (*Salvia* sp.), 1 ♂, 1 nymph, E. L. Mockford and J. D. Pinto; type locality, 29 March 1977, beating jojoba, 1 ♂ (teneral), collector not indicated; San Bernardino Co.: Camp Angelus, el. 1829 m, 3 May 1958, 2 ♂, 1 ♀, G. H. Nelson.

Discussion

The four European species recorded here are presumably introduced. This is suggested by their coastal distribution, two of them (*E. pallidus* and *E. westwoodi*) being known only from the city of Vancouver, British Columbia. The two new species appear to be native for the following reasons: they occur more inland, they occur on native vegetation, and they appear to share more character states than either one does with any European species. *E. guentheri* occurs throughout the Rocky Mountains in coniferous woodlands. *E. obscurus* occurs on chaparral vegetation in the foothills of the ranges paralleling the coast in southern California. The shared character states of these two species include the following: abdominal color pattern, female epiproctal color pattern, lack of a process of the median margin of the second valvula, and relatively large size in macropterous individuals. These shared character states suggest that the two species arose from a North American radiation of *Elipsocus*.

Key to Species of *Elipsocus* of Western North America

1. Males. Subgenital plate (hypandrium) evenly rounded posteriorly, subtending a closed phallic frame or phallosome (Fig. 36). All individuals macropterous 2
   Females. Subgenital plate with posterior margin in two lobes, each bearing several short, stout setae distally. Ovipositor valvulae conspicuous to sides of subgenital plate. Some individuals micropterous 6
2. Forewings very long, generally 3500–4500 μ. BR poorly developed, with 0–3 setae 3
   Forewings shorter, generally <3450 μ. BR moderately to well developed, with 3–9 setae 4
3. Head and well sclerotized regions of thorax medium reddish brown. Forewings <4000 μ. Rocky Mountain species .... *E. guentheri* n. sp.
   Head and well sclerotized regions of thorax dark chestnut brown. Forewing >4000 μ. California species .... *E. obscurus* n. sp.
4. Forewing relatively long, around 3400 μ; pterostigma relatively very long, FW/P = approx. 3.27–3.37. BR well developed, with 6–9 setae .... *E. pallidus* Jentsch
   Forewings shorter, <3300 μ; pterostigma relatively shorter, FW/P = 3.47–3.64. BR with 3–5 setae 5
5. Abdomen dorsally before clunium pale yellowish white. Forewings generally <3000 μ .... *E. occidentalis* Banks
   Abdomen at least slightly dark pigmented on terga 3–6. Forewings generally >3100 μ .... *E. westwoodi* McLachlan

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 260–264

NEW CALIFORNIA HYPERASPIS (COLEOPTERA: COCCINELLIDAE)

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This paper is based on a portion of a doctoral dissertation prepared by Ali A. El-Ali, while a student at the University of California, entitled "A Biosystematic Study of Hyperaspini of California with Emphasis on the Immature Stages." The dissertation was written under the direction of Dr. Kenneth S. Hagen of the Department of Biological Control, University of California, Albany, California. Plans for publication of the results of this thesis were terminated by El-Ali's death in 1977, and Dr. Hagen has encouraged me to publish at least a portion of the data.

El-Ali dealt with a number of subjects in his study, including a key to the California species of *Hyperaspis,* descriptions of a number of immatures, a review of the classification system of the tribe *Hyperaspini,* a study of certain biological attributes of species of *Hyperaspis,* suggested modifications in the groupings of United States *Hyperaspis* proposed by Dobzhansky (1941) and Watson (1969), and designation of four new species and one new subspecies of *Hyperaspis* found in California. The present paper deals with the new species only, but it is expected that additional results of El-Ali's work will be published at a later time.

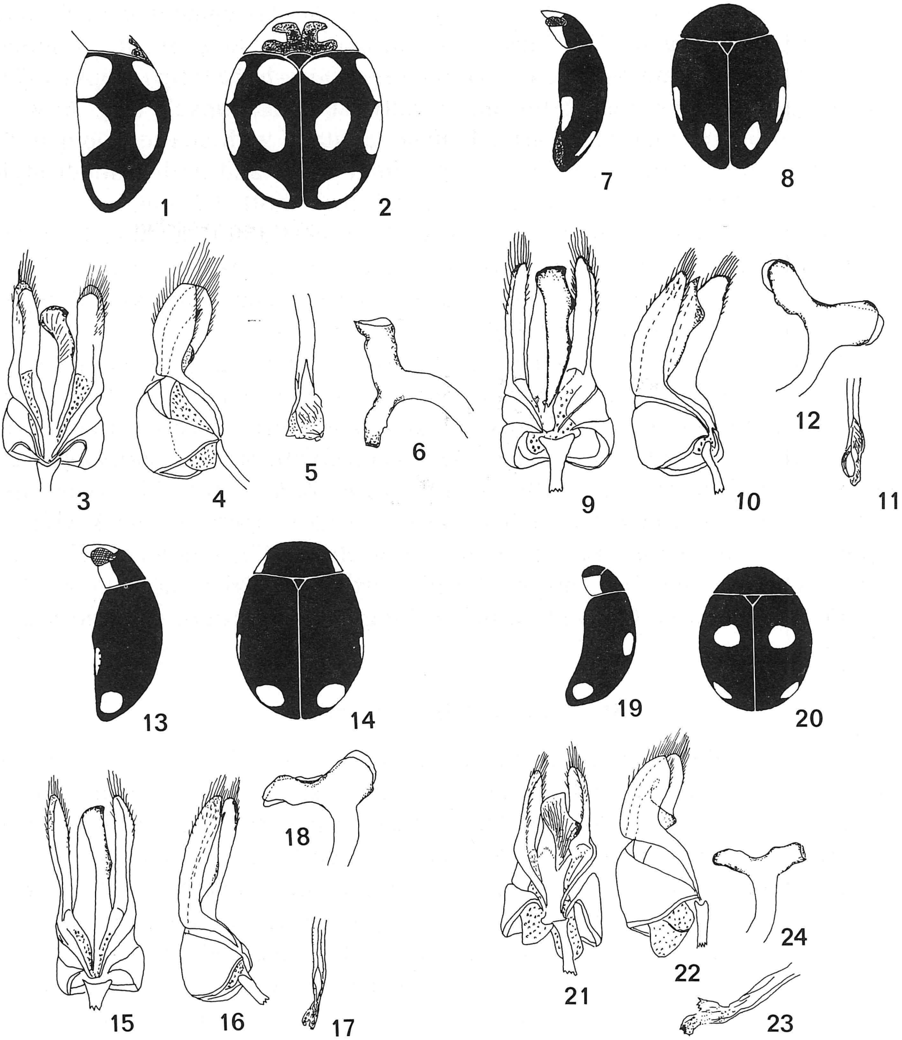
The author is deeply appreciative of Dr. Hagen's encouragement and of his assistance in the preparation of this paper.

In his thesis El-Ali designated four new species and one new subspecies (which is not treated here). The names he proposed are retained, with the exception of *H. hageni.* Dr. Hagen has requested that this species be named for El-Ali, and I am privileged to do so. Type labels prepared by El-Ali have not been removed from the specimens; however, labels designating Holotypes and Allotypes have been stricken and new labels supplied.

As indicated, paratypes have been placed in the following collections: CAS—California Academy of Sciences; USNM—United States National Museum; UCA—University of California–Albany; UCR—University of California–Riverside; WHN—W. H. Nutting.

Hyperaspis longicoxitis, new species

Broadly oval, strongly convex, each elytron with five distinct separate yellow spots (Figs. 1, 2). In males and females face yellow. In males labrum and mesepimeron yellow; in females, brown. Pronotum in females with a



Figs. 1–6. Hyperaspis longicoxitis, n. sp. Fig. 1, lateral view. Fig. 2, dorsal view. Fig. 3, tegmen, ventral view. Fig. 4, tegmen, lateral view. Fig. 5, tip of sipho. Fig. 6. siphonal capsule.

Figs. 7–12.—Hyperaspis elali, n. sp. Fig. 7, lateral view. Fig. 8, dorsal view. Fig. 9, tegmen, ventral view. Fig. 10, tegmen, lateral view. Fig. 11, tip of sipho. Fig. 12. siphonal capsule.

Figs. 13–18.—Hyperaspis querquesi, n. sp. Fig. 13, lateral view. Fig. 14, dorsal view. Fig. 15, tegmen, ventral view. Fig. 16, tegmen, lateral view. Fig. 17, tip of sipho. Fig. 18. siphonal capsule.

Figs. 19–24.—Hyperaspis mckenziei, n. sp. Fig. 19, lateral view. Fig. 20, dorsal view. Fig. 21, tegmen, ventral view. Fig. 22, tegmen, lateral view. Fig. 23, tip of sipho. Fig. 24. siphonal capsule.

pair of lateral vittae as wide as long. Antennae 11-segmented (6 funicle segments). Male genitalia (Figs. 3, 4) with median lobe evenly rounded apically, shorter than parameres; parameres spoon-shaped; tip of sipho (Fig. 5) enlarged, membranous, truncate apically; siphonal capsule (Fig. 6) with outer arm longer than inner arm. Female genitalia with coxites elongated, distinctly more than three times longer than wide, and with distinct styli bearing two long setae on each. Length 2.9 mm, width 2.2 mm.

Holotype.—Male. Jacumba, San Diego County, California, June 1955. D. C. Lloyd collector. (CAS). *Allotype*.—Female. Same data. (CAS).

Paratypes.—Total 14 (8 males and 6 females). Same data as holotype. (CAS), (USNM), (UCR), (WHN).

This species is unique among the *Hyperaspis* found in America north of Mexico in that the female coxites are narrow and elongated, not transverse as in the other groups in *Hyperaspis*. Also, the elytral pattern differs from that of any other species in our fauna. Species with similar characteristics do occur in Central and South America. The color pattern in this group, although usually consisting of five pairs of yellow spots on black elytra, sometimes consists of black spots on yellow elytra. The modification in the female coxite could be connected with certain biological attributes. For example, *H. notata* Mulsant, which belongs in this group, is a red scale feeder.

Hyperaspis elali, new species

Elongate oval (somewhat acuminate at apex), somewhat depressed, each elytron with a longitudinally oval apical spot (suggesting a remnant of a discal vitta), definitely closer to suture than to margin, and a midmarginal spot two times as long as wide, located between ½ to ¾ the length of the lateral margin, a trace of a marginal vitta extending apically (Figs. 7, 8). Lateral vittae on sides of pronotum slightly produced on anterior margin, distinctly narrowed posterially. Antennae 10-segmented (5 funicle segments). Male genitalia (Figs. 9, 10) with median lobe broad throughout, about as long as parameres, with subtruncate apex, convex side clearly bisinuate, forming two angulations, one acute at apical fourth, the other about at midmargin; tip of sipho (Fig. 11) with membranous part swollen in a semicircular shape at outer side; siphonal capsule (Fig. 12) with inner arm about as long as outer arm. Length 2.4–2.5 mm, width 1.6–1.7 mm.

Holotype.—Male. Yosemite National Park, Tuolumne County, California, February 5, 1955. R. Schuster collector. (CAS). *Allotype*.—Female. Eagle Peak Meadows, Alt 7050 ft, Tuolumne County, California, June 2, 1931. E. O. Essig collector. (CAS).

Paratypes.—Total 4 (2 males and 2 females). Lyell Canyon, Tuolumne County, California, August 8, 1935. Collector unknown. (CAS), (USNM), (WHN).

This species has been found only in a limited area in or immediately adjacent to Yosemite National Park. In addition to the specimens noted above, *H. elali* has been collected on willow in the Hall Natural Area, a few miles northwest of Tioga Pass (at the eastern border of the Park), at an elevation in excess of 3050 meters (10,000 feet).

H. elali belongs in the Annexa Group as defined by Dobzhansky (1941). In addition to differences in maculation, the male genitalia exhibit obvious differences. *H. annexa* Leconte has the median lobe as long as or longer than the parameres, evenly narrowing toward apex. *H. quadrivittata* Leconte has the median lobe clearly shorter than the parameres, angulated at apical third of the sclerotized side. *H. oregona* Dobzhansky has the median lobe longer than the parameres, sides more or less parallel, apex slightly bent, angulation feeble.

H. elali has a superficial resemblance to *H. querquesi,* n. sp. (which, however, belongs in the Postica Group) except that the apical spot of *H. elali* looks like a remnant of a discal vitta, definitely closer to the suture than to the margin. The apical spot of *H. querquesi* is transversely oval, not a remnant of a discal vitta, and definitely closer to the margin than to the suture.

Hyperaspis querquesi, new species

Elliptical, each elytron with a transversally oval apical spot and a narrow midmarginal spot, apical spot twice as far from suture as from lateral margin (Figs. 13, 14). Anterior margin of pronotum in males black. Antennae 10-segmented (5 funicle segments). Male genitalia (Figs. 15, 16) with median lobe somewhat shorter than parameres; apex slightly produced on one side, sides parallel with slight angulation at about midmargin of convex side; tip of sipho (Fig. 17) with membranous part not expanded, but open; siphonal capsule (Fig. 18) with outer arm twice as wide as, but shorter than inner arm. Length 2.6–2.9 mm, width 1.9–2.1 mm.

Holotype.—Male. Bird Observation Station, Marin County, California, November 14, 1970, collected on Quercus agrifola. Ali A. El-Ali collector. (Cas). *Allotype.*—Female. Same data. (CAS).

Paratypes.—Total 21 (10 males and 11 females). Same collecting data as type, except reared on *Phenacoccus solani* at Albany, California. (CAS), (USNM), (UCA), (WHN).

In addition to the specimens noted above, one female specimen from San Antonio Valley, Santa Clara County, California, collected by W. F. Barr, probably belongs here. It has not been designated as a paratype, however.

This species belongs in the Postica Group (which, however, should probably be redefined and broadened, rather than limited as in Dobzhansky (1941)). The related species can be separated by the elytral markings as well as by comparison of the male genitalia. Both *H. postica* Leconte and *H. quadrioculata* Motschulsky lack the strong angulation at convex side of the median lobe. In *H. oculaticauda* Casey the median lobe is subtruncate and relatively narrow at apex. In *H. arizonica* Dobzhansky the median lobe narrows evenly apically, with the tip broadly pointed. In addition, differences will be observed in the form of the siphonal capsules of these species.

Hyperaspis mckenziei, new species

Broadly oval, moderately convex, each elytron with a discal spot, more than two times as far from the margin as from the suture, rounded, and apical spot, transversely oval, more than two times as far from the suture as from the margin; spots not connected (Figs. 19, 20). Face with hair above epistomal ridge. Antennae 11-segmented (6 funicle segments). Male genitalia (Figs. 21, 22) with median lobe shorter than parameres, strongly angulated at convex side; parameres spoon-shaped, not constricted at apical third; tip of sipho (Fig. 23) slightly enlarged preapically, divergent apically with few membranous folds; siphonal capsule (Fig. 24) with arms about equal in length. Length 2.1–2.3 mm, width 1.7–1.8 mm.

Holotype.—Male. Palm Springs (near Palm Canyon), Riverside County, California, December 31, 1934, collected on Encelia farinosa. H. L. McKenzie collector. (CAS). *Allotype*.—Female. Same data. (CAS).

Paratypes.—Total 4 (1 male and 3 females). Same data as type. (CAS), (USNM), (WHN).

This species was named for its collector by El-Ali, and I am pleased to carry out his wishes.

This species differs from most other 4-spotted species in that the discal spots are closer to the suture than are the apical ones. It bears a superficial resemblance to *H. rotunda* Casey. However, *H. rotunda* is a larger insect with relatively larger elytral spots; and the shape of the median lobe of the male genitalia is different, with the tip subtruncate in *H. mckenziei*.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 265–267

A NEW SPECIES OF *ECHINISCUS* FROM CALIFORNIA (TARDIGRADA: ECHINISCIDAE)

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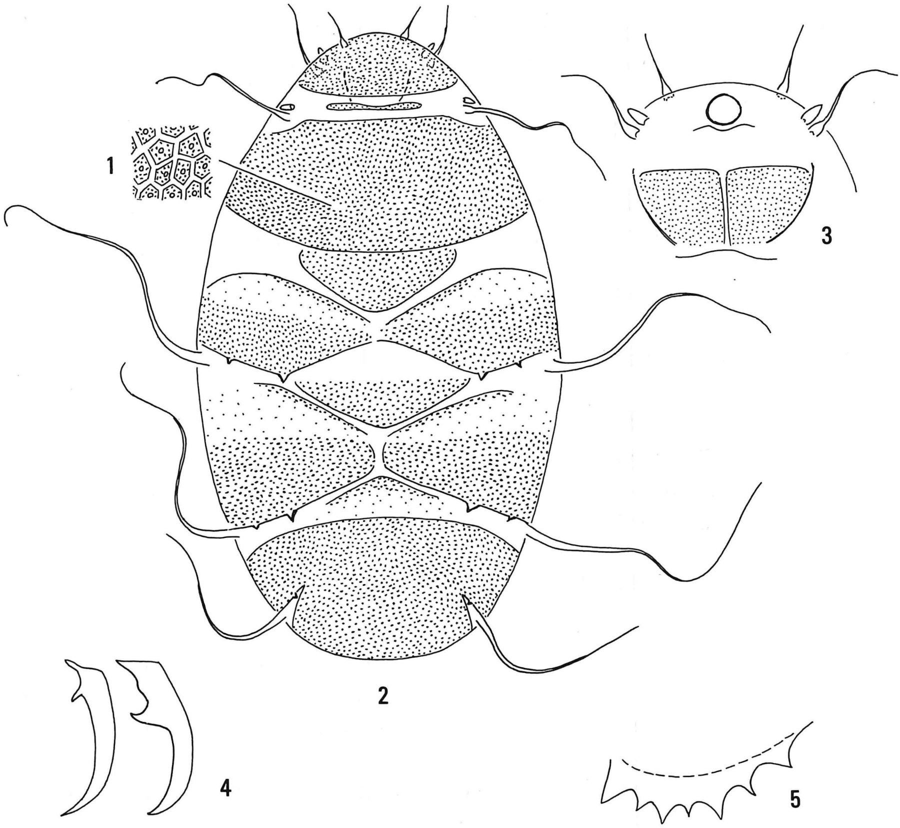
The tardigrade species *Echiniscus* (*E.*) *oihonnae* Richters was reported to occur in California (Schuster and Grigarick, 1965) based on specimens incorrectly determined at that time. Comparisons of specimens from California with recent acquisitions of *E. oihonnae* from European localities have brought this error to our attention, and we propose the following name for the species that we formerly considered to be *E. oihonnae*.

Echiniscus (Echiniscus) laterculus, new species
(Figs. 1–5)

Echiniscus (*Echiniscus*) *oihonnae,* Schuster and Grigarick (not Richters, 1904), 1965, Univ. of California Pub. in Zoology 76:53–54; Grigarick, Schuster and Toftner, 1975, Mem. Ist. Ital. Idrobiol., 32 Suppl. 133–151; Schuster, Grigarick and Toftner, ibid. 346, 362, 365.

Holotype.—Adult female. Length excluding legs IV 440 μm. Dorsal plates as shown by Fig. 2; sculpture of dorsal cuticle (Fig. 1) weak on anterior halves of plate pairs C and D, anterior half of median II and posterior margin of median III, absent between plates. Ventrally, two jugular plates distinctly granulate (Fig. 3). Head with internal buccal cirrus 25 μm long; external buccal cirrus 40 μm long; buccal papilla 10 μm long located near external cirrus. Lateral filament lengths (approx.) A 130 μm, C 200 μm, D 180 μm, E 130 μm. Dorsomedian and dorsolateral spines 9 μm or less. Dorsal surface leg IV minutely sculptured; fringe of 6 or 7 teeth (Fig. 5). Leg I with spine; leg IV with small papilla. Inner claws of legs I–IV with basally directed spur; outer claws of legs I–III simple, leg IV with small distally directed spur (Fig. 4).

Type series.—Holotype female. Riverton, El Dorado Co., California, II-1-1974, E. C. Toftner, R. O. Schuster. Deposited with the Department of Entomology, University of California, Davis, California. Paratypes, 150 specimens including larvae, juveniles and adults, all from the same locality with slides labeled as: Nr. Riverton (some with P. G. & E. Falls or P. G. & E. waterfall) El Dorado Co., III-7-1963 or 1965, R. O. Schuster; Riverton,



Figs. 1–5. *Echiniscus* (*E.*) *laterculus* Schuster, Grigarick and Toftner, new species. Fig. 1. Detail of dorsal sculpture. Fig. 2. Dorsal aspect. Fig. 3. Ventral surface of head, jugular plates stippled. Fig. 4. Inner and outer claws of leg IV. Fig. 5. Fringe of leg IV.

El Dorado Co., XI-5-1973, R. O. Schuster, E. C. Toftner; Riverton, El Dorado Co., II-1-1974, E. C. Toftner, R. O. Schuster. These specimens were removed from the mosses *Hypnum subimpoens* Lesq., *Anocolia menziesii* (Turner) Paris, and *Scleropodium touretii* (Brid.) L. Koch.

Etymology.—Latin m. dim., little tiles, for the regular pattern of the dorsal plates.

Discussion.—Information on the morphogenesis of this species (Grigarick, Schuster and Toftner, 1975) has been published with the name *E. oihonnae*.

By use of the keys in Ramazzotti (1972) *E. laterculus* can be determined as *E. clavisetosus* Mihelčič if the ventral plating is apparent or as *E. oihonnae* if the plating is not detected. A relationship to *E. clavisetosus* is indicated by the ventral plating and type of cuticular sculpture. The general appearance of *E. clavisetosus* differs markedly by the presence of filaments B and C^d and by the absence of filament E. Ramazzotti's key discriminates *E. oihonnae* in two species groups depending on whether there are lateral filaments in three or four positions additional to the scapular filament. All of the specimens from Europe that we have examined possess filament B, i.e., have lateral filaments in four positions. Filament B is consistently absent from *E. laterculus*. Another, perhaps more important, difference is in the nature of the cuticular sculpture. The polygons apparent for *E. oihonnae* are of uniform density whereas those of *E. laterculus* have a central pore surrounded by many dark granules (Fig. 1).

Echiniscus oihonnae was questionably listed for the fauna of Canada (Murray, 1910). The figure provided by Murray doesn't agree with the description or other figures of *E. oihonnae*. Riggin (1962) included the species in a key to *Echiniscus* for the United States without indicating a specific locality or whether or not specimens were seen. The absence of *E. oihonnae* from later surveys indicates that the species doesn't occur in North America.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 268–272

ENVIRONMENTAL FACTORS INFLUENCING HATCHING OF *TIPULA SIMPLEX* EGGS (DIPTERA: TIPULIDAE)

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The range crane fly, *Tipula simplex,* is a univoltine species found in the unirrigated pastures in the Central Valley of California. The eggs undergo a summer dormancy, and hatch in the late fall. The larvae feed on grass roots or cow manure. In most years, density ranges from <1–300 larvae/m^2, with no measureable effect on forage production. In outbreak years, the density reaches or exceeds 3000 larvae/m^2. At this density, the larvae denude the hills of all forage (Doane, 1908; Alexander, 1967; Hartman and Hynes, 1977).

These periodic high densities could be the result of extremely high fecundity of the spring females, differential hatching success of the eggs, and/or differential mortality of the early instar larvae.

Preliminary investigations indicated that fall hatches would occur if eggs were dried after they were oviposited, maintained at a long photoperiod in the summer, placed in a short photoperiod in September, and then moistened for two weeks, dried for one week, and then remoistened (Hartman and Hynes, 1977). Here we report on the effect of photoperiod, summer temperature, winter temperature, length of first drying, length of first moistening, and length of second drying on the hatching success of *Tipula simplex*.

Materials and Methods

Tipula simplex eggs were collected in the field in Tulare County, California. One hundred ml plastic cups were buried up to the lip, and were partially filled with moist sand. Females would fall into the cups, and since they are wingless, were trapped. Males would fly into the cups and copulate with the females, then leave. The females would oviposit in the moist sand.

The sand was dried and sifted to separate out the eggs. Fifteen thousand, two hundred eggs were counted into groups of 100 and stored dry in glass

Table 1. Effect of photoperiod on percent hatch.

# of eggs	Month of moistening	Photoperiod	Mean % hatch
400	October	10L:14D	58.4 a
400	October	12L:12D	62.0 a
400	October	14L:10D	35.5 b
400	October	16L:8D	0 c

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's Multiple Range Test.

petri dishes at 25°C at 16L:8D photoperiod. When hatching was to be induced, 100 eggs were transferred onto a piece of filter paper in a water-tight container 9 cm in diameter. The filter paper was moistened with 1.6 ml of distilled water and placed at 15°C at a 10L:14D photoperiod (light phase = 0.76 lux). After two weeks, the lids were removed for one day, allowing the paper to dry. After one week, the paper was remoistened with 1.6 ml of distilled water and the lid was replaced. Hatches were counted twice weekly. Four replicates were used for each test. All tests were performed in the manner described except where specifically stated otherwise.

To determine the effect of photoperiod, the eggs were dried until October, and when moistened, were placed at 10L:14D; 12L:12D; 14L:10D; 16L:8D, dried, and remoistened.

To determine the effect of length of first drying, the eggs were first moistened 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 months after oviposition.

To determine the effect of summer temperature, eggs were placed in one of the following temperatures (degrees Celsius) in June and held there until September: 25°; 35°; 45°; 35° day/20° night; 45° day/20° night; 55° day/35° night. In only this experiment, the eggs were left in sand until September.

To determine the effect of fall temperature, eggs were held until September, then subjected to one of the following temperatures (° Celsius): 35°; 25°; 15°; 5°; 30° day/15° night; 25° day/15° night; 15° day/5° night.

To determine the effect of the length of the first moistening, eggs were held until October, then moistened for 4, 7, 10, 14, 21 or 28 days, then dried for 7 days, then remoistened.

To determine the effect of the length of the second drying, eggs were held until October, then moistened for two weeks, then dried for 0, 3, 7, 10, 14, 21 or 28 days, then remoistened.

Results and Discussion

Photoperiod.—Results are shown in Table 1. A scotophase of 12 or 14 hours allows maximum hatching; under a scotophase of 8 hours eggs will

Table 2. Effect of length of first drying on percent hatch.

# of eggs	Month of moistening	Photoperiod	Mean % hatch	S.E.
400	April	10L:14D	0 c	0
400	May	10L:14D	0 c	0
400	June	10L:14D	0 c	0
400	July	10L:14D	0 c	0
400	August	10L:14D	29.0 b	2.3
400	September	10L:14D	38.0 b	3.0
400	October	10L:14D	58.4 a	2.0
400	November	10L:14D	60.0 a	1.9
400	December	10L:14D	30.0 b	3.7
400	January	10L:14D	29.0 b	2.1
400	February	10L:14D	0 c	0

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's Multiple Range Test.

not hatch. With a 10 hour scotophase the eggs have a significant hatch rate, but this rate is reduced significantly from that observed under a longer scotophase.

Length of first drying.—As can be seen in Table 2, August is the earliest time at which the eggs hatched, even though the photoperiod is artificially decreased as early as April. Hatching can be induced anytime from August through January, but those which are exposed to water in October and November have a significantly greater hatching rate than those exposed either earlier or later.

Summer temperatures.—Results are shown in Table 3. Lower summer temperatures give a significantly higher hatching rate, indicating that high temperature is a definite stress on the eggs. Although the highest hatching success occurs in the lowest temperature tested (25°C), we did not test lower

Table 3. Effect of summer temperature on percent hatch.

# of eggs	Summer temperature	Month of moistening	% Hatch	S.E.
400	25°	September	37.8% a	3.0
400	35°/20°	September	25.3% b	4.2
400	35°	September	12.2% c	3.7
400	45°	September	0 d	0
400	45°/20°	September	0 d	0
400	55°/35°	September	0 d	0

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's Multiple Range Test.

Table 4. Effect of fall temperature on percent hatch.

# of eggs	Fall temperature	Time	% Hatch	S.E.
400	15°	September	39.0 a	6.1
400	15°/5°	September	20.5 b	3.8
400	25°/15°	September	19.8 b	0.1
400	5°	September	16.0 b	1.0
400	35°	September	2.5 c	0.3
400	25°	September	0.8 c	0.1
400	30°/15°	September	0 c	0

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's Multiple Range Test.

summer temperatures, because 25°C was already 15°C or more below the temperatures occurring in the field during summer days.

Fall temperatures.—Results are shown in Table 4. A constant temperature of 15°C provides significantly higher hatch success than any other test temperature. Constant temperatures higher than 15° are very poor at inducing hatching. An intermediate level of hatches occurs when daytime temperature is as high as 25° if nighttime temperature is 15°, or when nighttime temperature is 5°.

Length of first moistening.—Length of first moistening from 4 to 28 days has no significant effect on the hatching success. Per cent hatch ranges from 42.3 to 51.8 (not significant at $P < 0.05$ according to the Duncan Multiple Range Test).

Length of second drought.—Results are shown in Table 5. A second drying period of at least one week gives maximal hatch.

Outbreak versus nonoutbreak years.—If the hatching success is a major factor in causing outbreaks, we should find that outbreak years differ from

Table 5. Effect of length of second drought on percent hatch.

# of eggs	Length of time (days)	Time	% Hatch	S.E.
400	7	October	51.8 a	5.3
400	14	October	50.8 a	4.6
400	21	October	42.9 ab	4.2
400	28	October	35.2 b	6.7
400	10	October	34.6 b	6.0
400	3	October	34.5 b	2.8
400	0	October	6.4 c	1.5

Numbers followed by the same letter are not significantly different ($P < .05$) according to Duncan's Multiple Range Test.

nonoutbreak years by the following criteria: summer temperatures should be cooler, fall temperatures should be closer to 15°C, and/or the first rainfall should be closer to October and November. There should be a definite break between the first set and second set of rains which will allow the fields to dry out, although the amount of rain in the first set and the amount of time between the first and second set should not be important.

Tulare County has had devastating crane fly outbreaks in the winters of 1960–1961, 1966–1967, and 1972–1973. We compared the weather for outbreak and nonoutbreak years, using data collected by the U.S. Weather Bureau from 1960–1976 in Lindsey, Tulare County. Neither summer nor winter temperatures are statistically different in outbreak and nonoutbreak years, assuming that no significant difference between air temperatures in any two years translates to no significant difference between soil temperatures in those two years. Neither October nor November average temperatures in outbreak years are significantly different from nonoutbreak years. In every year there is a definite break between first rainfall in September (rarely October) and later rains in October or November which, on the average, start in late October (Table 6).

Conclusions

Hatching can be induced in *Tipula simplex* eggs between August and January, but hatching success is greatest in October and November.

The presence of a second drying period after an early fall rain is essential. Higher hatching success occurs under cooler summer temperatures, and under moderate (15°C) fall temperatures, rather than under very warm or very cold temperatures.

However, in Tulare County the October and November temperatures and the time of the second rainfall do not vary significantly between outbreak and nonoutbreak years. We must conclude that some other factors, such as larval survival or female fecundity, is responsible for the extremely high densities which occur about once every six years.

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Footnote

[1] The authors would like to acknowledge the assistance of the Boston Land Company and the Tulare County Agricultural Commission.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 273–276

THE NEARCTIC TRICHOMYIINAE (DIPTERA, PSYCHODIDAE)

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While examining the type-specimens of the Nearctic species of the genus *Trichomyia* Haliday it became evident that, in addition to *T. nuda* (Dyar), *T. wirthi* Quate and *T. sequoiae* Quate, there is an undescibed species, which has been overlooked by Quate (1955). The drawings of his study simplify the complicated construction of the genitalia and the features most important for species-distinction were not taken into account. It is therefore the purpose of this short paper to point out the decisive differences of the genitalia of the species mentioned above and of the new species.

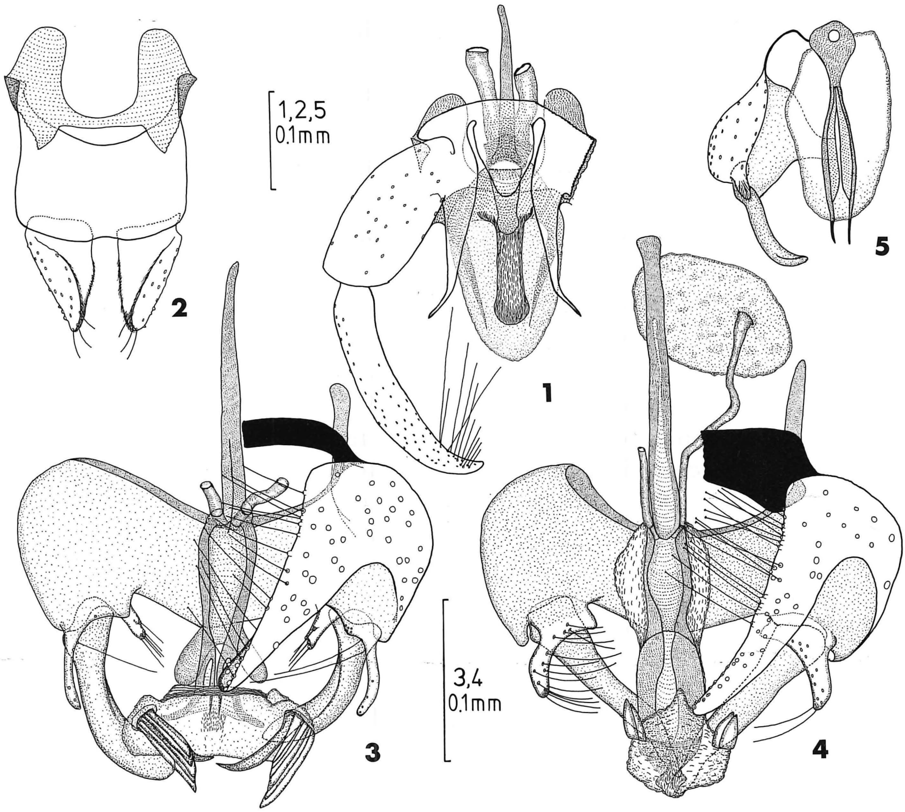
I want to thank Dr. Paul H. Arnaud Jr. (California Academy of Sciences, CAS) and Dr. Christian Thompson (U.S. National Museum, Washington D.C., USNM) for the loan of specimens.

Trichomyia nuda (Dyar)
(Figs. 1–2)

Material examined.—4 ♂, Fields Church, Va Holmes Run, 6-VI-1961, 15-VI-1961, 1-VII-1961, 2-IX-1961 (all W. W. Wirth, light trap) 1 ♂, "Maruina" nuda Dyar Md 2246 (all in the USNM) 1 ♂, Buffalo N.Y. VI.15.09 Mc Van Duzee; 1 ♂ Gowanda N.Y. VI.14.12 Mc Van Duzee; 1 ♀ East Aurora N.Y. VI.22.12 Mc Van Duzee (all specimens in CAS).

Description.—For a general description and the measurements refer to Quate (1955, p. 117–119).

Genitalia.—Dististyle slightly curved and a little longer than basistyle. 9th sternite with 3 distal prolongations, the middle one shorter and rounded, the lateral pair thinner, with their tips bent outward. The basal part of the aedeagus consists of an apodeme and of 2 gonoducts, which fuse immediately before their entrance into the seminal pump at the distal end of the apodeme. The distal part of the aedeagus consists of a thin plate and morphologically below it there is the intromitting part of the penis. Morphologically above the plate the 2 inner dorsal apodemes of the basistyles, which seem to support the aedeagus, join and form a small bridge. 9th tergite normal with 2 hirsute cerci.



Figs. 1–5. Figs. 1–2, *Trichomyia nuda* (Dyar): 1, styles, aedeagus and ventral bridge 2, 9th tergite and cerci with the apodeme of the basistyles. Fig. 3, trichomyia sequoiae Quate: styles, aedeagus and ventral bridge. Fig. 4, trichomyia californica n. sp.: styles, aedeagus and ventral bridge. Fig. 5, trichomyia wirthi Quate: styles and aedeagus.

Trichomyia sequoiae Quate
(Fig. 3)

Material examined.—Holotype (♂) Orick, Humboldt Co., California 3-VII-50 (L. W. Quate); allotype (♀) same data, both specimens in CAS. Paratype (♂) same data as holotype, in USNM.

Description.—For a general description and measurements of antenna, palp and wing refer to Quate (1955, p. 120).

Genitalia.—Basistyles each with a ventral prolongation, which is ornated by strong setae, bearing an apical knob (most of the knobbed setae of the holotype are broken, but they are visible in the paratype). Dorsally they are fused and ventrally joined by a rather thin sternal bridge. Basistyles basally with a small apodeme, distally near the articulation of the dististyles there are two prolongations, which are parts of the basistyles. The lateral prolongation slightly curved, the inner one strong with 4 or 5 setae. Dististyles bent medially with rounded tips. All these parts surround and protect the aedeagus, which is placed between them. Aedeagus consists of a basal apodeme, and 2 lateral gonoducts lead into the basal part of the characteristic vase-shaped seminal pump. The distal part of the seminal pump leads into a thinwalled sack, bearing 6 flattened spines on each side, the tips of the 2 stronger inner spines bent medially.

Trichomyia californica, new species
(Fig. 4)

Material examined.—Holotype (♂) Mill Valley, Marin Co., California 26-V-26 Mc Van Duzee (Diaphone VIII 51 LWQ), wrongly associated paratype of *Trichomyia sequoiae* Quate. Holotype deposited in the CAS (CAS Ent. Type No. 13527).

Description.—Vestitute similar to *T. sequoiae.*

Head.—Eyes separated by a distance of 4 facet diameters. Scape larger than pedicel, flagellar segments elongate pyriform, each bearing 2 ascoids, which are twice as long as the segments. Palpus 3-segmented, first segment with a group of sensory rods in a circular depression, the following segments shorter than the first; ratio of segments 4-3-3. Thorax and abdomen without characteristic features. Wing length 2.7 mm.

Genitalia.—Compared with *T. sequoiae* the ventral bridge is very strong. Basistyle of the same shape as in *T. sequoiae,* also with knobbed setae. There is only 1 appendage near the articulation of the dististyles, its shape is quadrangular with a lateral prolongation. The dististyles are long and slender and their tips are bent caudally. Gonoducts as in *T. sequoiae,* shape of seminal pump different, and in particular, its walls are much stronger. The thin distal sack is comparatively small and bears only 2 triangular plates on each side.

Relations.—The new species is closely related to *T. sequoiae* Quate, but differs from it by the shape of the ventral bridge, the styles and the seminal pump. Furthermore, the thinwalled sack, which is much smaller in *T. californica* n. sp., bears only 2 spines on each side instead of 6 in *T. sequoiae.* I assume the differences between these 2 species have been overlooked, because the thinwalled sack and its spines, which are poorly sclerotized, are nearly invisible. Another reason might be the small size of the genitalia.

Trichomyia wirthi Quate
(Fig. 5)

Material examined.—Holotype (♂) and allotype (♀), both L. Worth Flo. 1-VIII-51 (light trap W. W. Wirth) (specimens in the USNM).

Description.—For a general description and the measurement refer to Quate (1955, p. 119).

Genitalia.—Basistyle with a short apical prolongation ventrally, dististyle slender, its tip slightly bent medially. Apodeme of the aedeagus flattened horizontally with a hole in its base, which might represent the entrance of the gonoduct, because in *Trichomyia brasilensis* Satchell, which is similar in this respect, an annulated tube is attached to this perforation (the type from the British Museum (Nat. Hist.) has been examined). The distal part of the aedeagus consists only of 2 lateral lamellae surrounded by a thin membranous sack.

Relations.—Concerning all known features of body, wing and genitalia, it is my opinion that there are no close relations of *T. wirthi* to any species of the now known Nearctic Trichomyiinae and to any other species of the genus *Trichomyia*.

While the characteristics used to distinguish subgroups within *Trichomyia* (Duckhouse 1965, 1972, 1978) clearly place *T. nuda* (Dyar) into the "group A" (4-segmented palpus, shape of the styles etc.), *T. sequoiae* Quate and *T. californica* n. sp. fall into "group B" (3-segmented palpus, shape of the basistyles, articulation of the dististyles etc.). *T. wirthi* Quate does not seem to be a member of any of these groups, in view of the rather simple build of the aedeagus and gonoducts.

Summary

The genitalia of the four known species of Nearctic Trichomyiinae, *T. nuda* (Dyar), *T. sequoiae* Quate, *T. californica* n. sp. and *T. wirthi* Quate are described and figured. The placement of these species into subgroups of Trichomyia are briefly discussed.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 277–282

NEW GENERA AND A NEW SPECIES OF NEW WORLD CLERIDAE (COLEOPTERA)[1]

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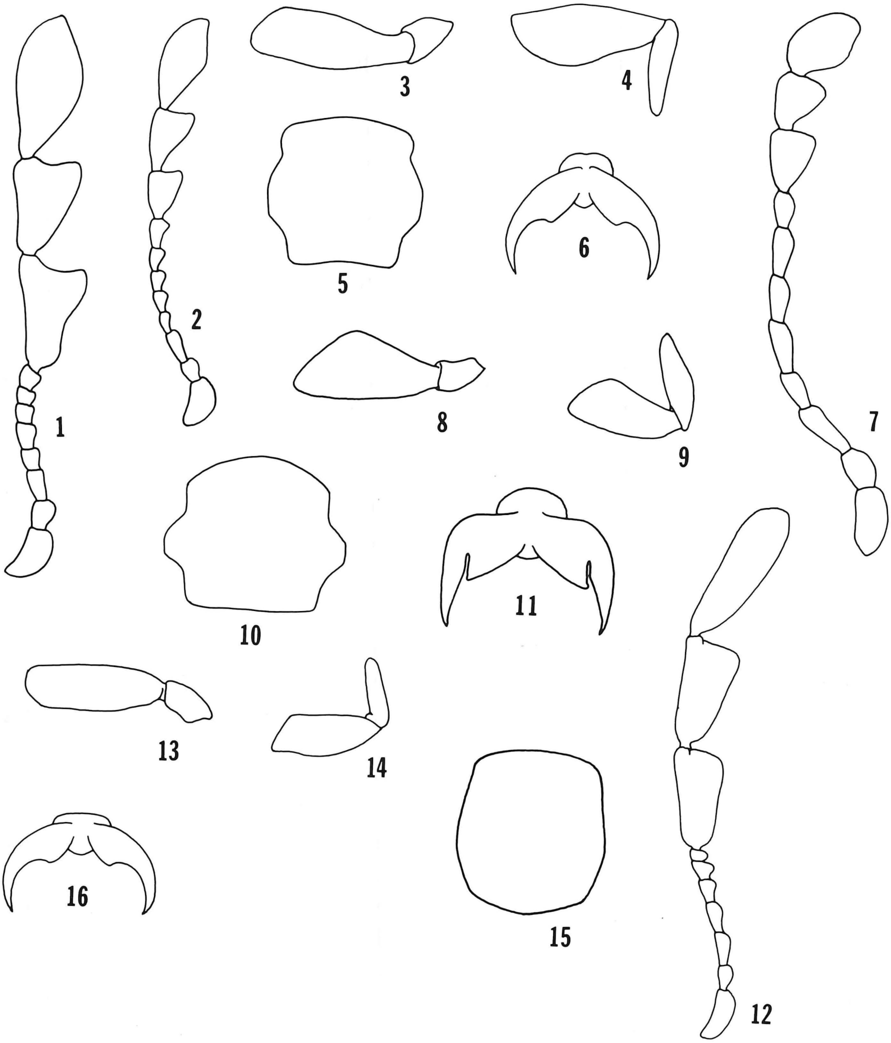
In preparing for the coverage of the Cleridae in the new Catalogue of North American Coleoptera it has become apparent that a number of generic name changes will be necessary before a satisfactory listing of the species can be accomplished. In this paper, which deals with several groups of the Enopliini, two new generic names are provided for two North American species and a North American genus formerly in synonymy is resurrected. Also, a new generic name is provided for some South American species, which in turn will now allow for a more realistic arrangement of another genus, several species of which occur in North America.

Boschella, new genus

Enopliini, *Head* subquadrate; eyes moderate in size, finely faceted, broadly, rather deeply emarginate behind antennal insertion; antenna (Figs. 1 and 2) 11-segmented, segment 1 enlarged, slightly less than twice as long as the subglobular segment 2, segments 3 and 4 somewhat elongate, segments 5–8 compact, subglobose, segments 9–11 forming a loose club, segments 9 and 10 abruptly enlarged, subequal, elongate-triangular, somewhat flattened, male with apical angle of inner margin slightly prolonged, acute, segment 11 elongate with apical half of inner margin slightly emarginate; maxillary palpus with last segment subcylindrical (Fig. 3), labial palpus with last segment elongate-triangular (Fig. 4). *Pronotum* (Fig. 5) convex, coarsely punctate, disk broadly flattened, usually with a faint longitudinal ridge or tumescence on either side of middle; margins entire, lateral and hind margins slightly ridged; lateral margin rather abruptly, broadly expanded at middle; front and hind angles broadly rounded. *Elytra* elongate, subcylindrical, covering abdomen; surface coarsely, densely punctate, mostly serially arranged; epipleuron indistinct, narrow, extending to middle of elytron. *Anterior coxal cavities* broadly open behind, proepimeron narrowly triangular behind cavity, transversely extending to about outer hind cavity. *Legs* rather slender; fore tibia not serrate along front margin or apically toothed; tarsal segment 1 narrow, plantula distinct, segments 2 and 3 apically expanded with well developed, rounded plantula; pretarsal claws rather large, with a slight basal lobe (Fig. 6).

Type of genus: *Enoplium fasciatum* LeConte.



Figs. 1–16. Figs. 1–6, *Boschella*: 1, antenna of male; 2, antenna of female; 3, maxillary palpus, last two segments; 4, labial palpus, last 2 segments; 5, outline of pronotum in dorsal view; 6, pretarsal claws. Figs. 7–11, *Exochonotus*: 7, antenna; 8, maxillary palpus, last two segments; 9, labial palpus, last two segments; 10, outline of pronotum in dorsal view; 11, pretarsal claws. Figs. 12–16, *Parapelonides nigrescens* Schaeffer: 12, antenna; 13, maxillary palpus, last two segments; 14, labial palpus, last two segments; 15, outline of pronotum in dorsal view; 16, pretarsal claws.

Boschella is erected to receive the Californian species currently listed in Corporaal's Catalogue of the Cleridae as *Corinthiscus fasciatus* (LeConte) and its synonym *C. trilobatus* (VanDyke). However, the affinities of this genus are not with *Corinthiscus* s.s., but rather with the *Pelonium* section of that genus and with the genus described here as *Exochonotus*. *Boschella* can be recognized by a combination of features which include the finely faceted eyes, the non-lobed first and second segments of the antennal club, the entire front margin of the fore tibia, the narrow and shortened elytral epipleura and differently shaped last segment of the maxillary and labial palpi.

This genus is dedicated to a friend and colleague, the late Robert van den Bosch of the University of California who effectively carried the banner of Biological Control with dedication and forthrightness during his productive career.

Exochonotus, new genus

Enopliini, *Head* subquadrate; eyes moderate in size, coarsely faceted, broadly, moderately emarginate behind antennal insertion; antenna (Fig. 7) 11-segmented, segment 1 enlarged, slightly more than twice as long as subcylindrical segment 2, segments 3–8 filiform, segments 9–11 forming a loose club, segments 9 and 10 moderately enlarged, subequal, elongate-triangular, indistinctly flattened, segment 11 subovate to elongate in outline; maxillary palpus and labial palpus with last segment triangular (Figs. 8 and 9), maxillary palpus larger. *Pronotum* (Fig. 10) convex, coarsely punctate; disk subflattened or irregularly contoured; margins entire, lateral and hind margin slightly ridged; lateral margin angulately lobed at middle; front and hind angles subrectangular. *Elytra* elongate, subcylindrical, covering abdomen; surface coarsely, densely punctate, serially arranged; epipleuron distinct, narrow, extending from base to near apices. *Anterior coxal cavities* open behind, proepimeron narrowly triangular behind cavity, transversely extending to midpoint of cavity. *Legs* rather slender; fore tibia not serrate along front margin or apically toothed; tarsal segment 1 narrow, plantula distinct, segment 2 slightly wider, plantula distinct, segment 3 expanded, ovate, with plantula rounded apically; pretarsal claws rather large, with a slight basal tooth or a distinct basal lobe (Fig. 11).

Type of genus: *Lebasiella varipennis* Spinola.

In addition to the type species which is transferred from *Cregya*, *Pelonium tuberculatum* Pic and *P. lobaticolle* Lesne are included in *Exochonotus*. They are transferred from *Corinthiscus* where they have been placed in Corporaal's Catalogue.

This genus which is restricted to South America shows similarities with *Boschella* in antennal structure, general body form, the entire front margin of the front tibia and in the serially arranged punctation of the elytra. They differ in the form of the last segment of the maxillary and labial palpi, the nature of the elytral epipleura and in the size of the facets of the eyes. *Exochonotus* shows an intermediate condition with respect to the toothing of the pretarsal claws. A slight toothed condition exists on some specimens examined whereas the others have the claws basally lobed.

Pelonides Kuwert

Pelonides Kuwert, 1894, Ann. Ent. Soc. Belg. 38:8.

This North American genus has been incorrectly associated with the South American genus *Pyticara* by several clerid workers over the years and most recently was listed as a synonym of that genus in Corporaal's Catalogue of the Cleridae. After studying nearly all the type specimens of the assigned specimens, I can only conclude that *Pelonides* must be regarded as a distinct genus and one that is not related to *Pyticara*. This is indicated by the antennae which are 10-segmented and have the first two segments of the club lobed in *Pelonides* and are 11 segmented and have the segments of the club parallel-sided in *Pyticara*. Also, the pretarsal claws are feebly lobed in *Pelonides* and basally toothed in *Pyticara*; the front tibia has the anterior margin entire in *Pelonides* and serrate in *Pyticara*; and the epipleura is weakly reflexed in *Pelonides* and strongly reflexed in *Pyticara*.

The following names, as listed in Corporaal's Catalogue under *Pyticara*, are recognized as belonging to *Pelonides*:

1. *granulatipennis* (Schaeffer)
2. *humeralis* (Horn)
   militaris (Chevrolat)
   perroudi (Pic)
3. *quadripunctata* (Say)
   quadrinotata (Haldeman)
4. *scabripennis* (LeConte)
5. *similis* Knull

Parapelonides, new genus

Enopliini, *Head* subquadrate; eyes small, finely faceted, deeply emarginate behind antennal insertion; antenna (Fig. 12) 10-segmented, segment 1 enlarged, twice as long as subglobular segment 2, segments 3–5 nearly filiform, segments 6 and 7 shorter and slightly thicker, segments 8–10 forming a loose club, segments 8 and 9 abruptly enlarged, subequal, subflattened, subtriangular, segment 10 slightly longer than segment 9, narrowly ovate; maxillary and labial palpus with last segment subcylindrical (Figs. 13 and 14). *Pronotum* (Figs. 15 and 17) subovate in dorsal view, strongly convex;

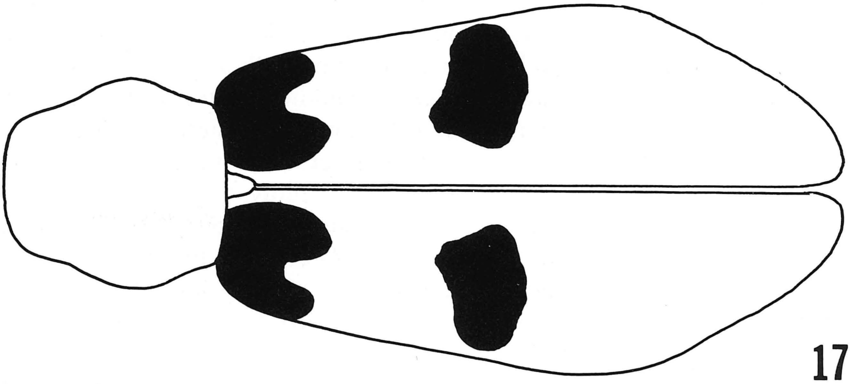


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Fig. 17. *P. beckeri* Barr, pronotum and elytra.

margins entire, lateral and hind margins slightly ridged; lateral margin arcuate to slightly lobed at middle; front and hind angles broadly rounded. *Elytra* subovate, broadest behind middle, covering abdomen; coarsely punctate; epipleuron distinct, rather narrow, broadest below humeri, gradually narrowing to area of greatest elytral width near the apical fourth. *Anterior coxal cavities* narrowly open behind, proepimeron narrowly triangular behind cavity, transversely extending at least to midpoint of cavity. *Legs* rather slender; fore tibia not serrate along front margin or apically toothed; tarsal segment 1 narrowed, plantula inconspicuous, segments 2 and 3 apically expanded with well developed rounded plantula; pretarsal claws small with a slight basal lobe (Fig. 16).

Type of genus: *Enoplium nigrescens* Schaeffer.

Parapelonides is allied to *Pelonides*. The two genera are separated by the first and second segments of the antennal club being slightly triangular in *Parapelonides* and apically lobed in *Pelonides,* by the elytra being densely punctate in *Parapelonides* and entirely or in part granulose in *Pelonides* and by the pretarsal claws being conspicuously smaller in *Parapelonides*.

The genus is represented by two species, *P. nigrescens* from southern Texas and adjacent Mexico which is transferred from *Pyticara* and the following undescribed species.

Parapelonides beckeri, new species
(Fig. 17)

Female: Somewhat shining; yellow-orange, elytra with a pair of irregular black markings at base and a pair of transverse, black discal spots in front of middle, antennae and legs black except trochanters and basal half of upper and lower surfaces of fore femora yellowish. *Head* rather densely, irregularly punctate, moderately clothed with short, suberect brown hairs; front broadly subdepressed at middle. *Pronotum* densely punctate laterally, less densely punctate medially, densely clothed with short, suberect brown hairs; lateral margins somewhat lobed at middle. *Elytra* with punctations serially arranged, rather coarse, deep, becoming obsolete at apical fourth, rather densely clothed with erect and suberect, short tawny hairs and with a few longer hairs at sides; lateral margins feebly bisinuate along apical fourth; apices broadly rounded. *Ventral* surface impunctate, indistinctly pubescent; metasternum strongly convex. *Legs* with femora impunctate, tibiae densely, irregularly punctate. *Length*: 4 mm, width 1.8 mm.

Holotype, male (Canadian National Collection), from 12 mi west of Olanchito, Honduras, Jan. 1949, E. C. Becker.

Parapelonides beckeri, the second known species of the genus, is readily separated from the other, *P. nigrescens,* by several features. Most obvious with this new species the elytra have two pairs of dark spots rather than a pair of broad dark vittae; the elytral punctations are serially arranged rather than being irregularly and densely placed; the sides of the pronotum are slightly lobed at the middle rather than being evenly arcuate; and the middle and hind legs are mostly blackish rather than being distinctly bicolored.

This species is named after the collector of the type specimen, Dr. Edward C. Becker, Curator of the Canadian National Collection, in acknowledgment of the many favors he has extended me over the years.

Footnote

[1] Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper No. *8061*.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 283–288

LIFE HISTORY OF A FRUIT FLY, *PROCECIDOCHARES* SP., ON THE RAGWEED, *AMBROSIA DUMOSA* (GRAY) PAYNE, IN SOUTHERN CALIFORNIA (DIPTERA: TEPHRITIDAE)

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One of several species of gallicolous, stenophagous insects associated with the native, perennial ragweed, *Ambrosia dumosa,* in southern California (Goeden and Ricker, 1976a), this tephritid first was identified for us as *Procecidochares stonei* Blanc and Foote by F. L. Blanc (pers. commun.), based on what was known of this group at that time. Subsequently, R. H. Foote (pers. commun.) determined that it and a different species reared from stem galls on *A. eriocentra* (Gray) Payne (Goeden and Ricker, 1976b) are both undescribed *Procecidochares.* We herein describe the life history of the tephritid on *A. dumosa,* which we call *Procecidochares* sp. in anticipation that its taxonomy will be clarified elsewhere in the future. Little information otherwise is available on the biologies of California *Procecidochares* spp. (Foote and Blanc, 1963; Tauber and Tauber, 1968).

Host-plant and distribution.—Separate *Procecidochares* spp. gall congeneric species of Compositae (Steyskal, 1974). Only 2 of the 9 species of *Ambrosia* (subtribe Ambrosiinae) native to southern California host *Procecidochares* spp. (Goeden and Ricker, 1974a, 1974b, 1975, 1976a, 1976b, 1977c). And yet, *P. stonei* reportedly has been reared from *Viguirea laciniata* Gray (Foote and Blanc, 1963) and *Chrysothamnus viscidiflorus* (Hooker) Nuttall (Tauber and Tauber, 1968), host-plants belonging to a different subtribe (Verbesininae) and tribe (Astereae) of Compositae (Munz and Keck, 1957), respectively. It is unlikely that these Compositae are galled by a single species of tephritid, *P. stonei.*

Galls characteristic of *Procecidochares* sp. were observed on *A. dumosa* at the following locations in southern California: Imperial Co.—Durmid, Niland, Ocotillo; Los Angeles Co.—Llano; Riverside Co.—Desert Center, Mecca, Palm Springs; San Bernardino Co.—Amboy, Apple Valley, Clarks Pass, Twentynine Palms, Yucca Valley; San Diego Co.—Borrego Springs.

Biology.—Field data reported herein were obtained at a study site located 8 km northwest of Palm Springs, where a large population of this tephritid had been detected by Goeden and Ricker (1976a). Laboratory and insectary studies were conducted at Riverside. Insectary conditions were 27 ± 1°C, 40–70% relative humidity, and a 12/12-hr (light/dark) photoperiod.

Egg.—The egg is elongate-ellipsoidal, translucent white, and tapers at its micropylar end to a pedicel. Mean (±S.D.) measurements of 31 eggs were: egg body length, 0.38 ± 0.06 mm; greatest width, 0.17 ± 0.06 mm; and pedicel length, 0.10 ± 0.02 mm.

Eggs were inserted, cephalic pole first, between the unexpanded, young leaves of axillary and terminal buds. Usually 1 (rarely 2) egg per bud was found in field samples, but as many as 17 eggs were recovered from a single axillary bud in insectary cagings. In the field, most oviposition occurred in axillary buds located 3–20 cm from the apex of the current season's branch growth. The incubation period was 7–8 days.

Larva.—There are 3 larval instars. Twenty-two, 10, and 26 first through third instars averaged 0.16 ± 0.03 mm, 1.09 ± 0.25 mm, and 3.17 ± 0.50 mm in length, respectively; 0.10 ± 0.01 mm, 0.46 ± 0.06 mm, and 1.39 ± 0.28 mm in greatest width, respectively. The cephalopharyngeal skeletons of these 3 instars averaged 0.08 ± 0.01 mm, 0.15 ± 0.03 mm, and 0.27 ± 0.05 mm in length and 0.04 ± 0.01 mm, 0.10 ± 0.01 mm, and 0.21 ± 0.09 mm in greatest width, respectively.

The newly hatched larva tunneled directly into the bud and caused it to swell laterally, while halting internode elongation. Thus, the young gall (Fig. 1a) consisted of a small, compact rosette of stunted, sessile leaves distinct from ungalled buds and the senescent and dead, semi-persistent, grey-green leaves of the terminal branches. Fifteen galls containing aestivating first instars collected in mid-summer (early July) measured 2.5 ± 0.46 mm externally, 0.7 ± 0.49 mm internally, and 0.59 ± 0.19 mm in wall thickness.

Larval and gall development resumed concurrent with the vegetative host-plant growth that followed periods of substantive, summer and winter rainfall. Dissections of 20 galls collected at the study site each day after torrential rains fell on September 10, 1977, indicated that the second and third stadia lasted only 3–6 days and 4–5 days, respectively, under field conditions. Second and third instars fed actively by rasping the inner wall of the expanding gall with their mouthhooks, thus excavating a round or ellipsoidal, superficially smooth-surfaced, central cavity (Fig. 1b). This gall lumen eventually reached 2–3 times the size of the third instar. The central cavities of 15 fully developed galls measured 5.83 ± 0.33 by 4.71 ± 0.58 mm. The mature larva used its mouthooks to dig an exit tunnel, 1.29 ± 0.12 mm wide (N = 15), leading from the lumen to the gall apex (Fig. lb). Material removed in constructing this exit tunnel apparently was ingested, as the gall lumen remained free of debris. The exit tunnel was completed in 1–3 days. The larva then returned to the central cavity, ceased feeding, and pupariated.

Pupa.—Twenty puparia averaged 4.09 ± 0.27 mm in length; 1.77 ± 0.18 mm in greatest width. During pupariation, gall growth ceased, but the tissues remained green and succulent. Under insectary conditions, adults emerged

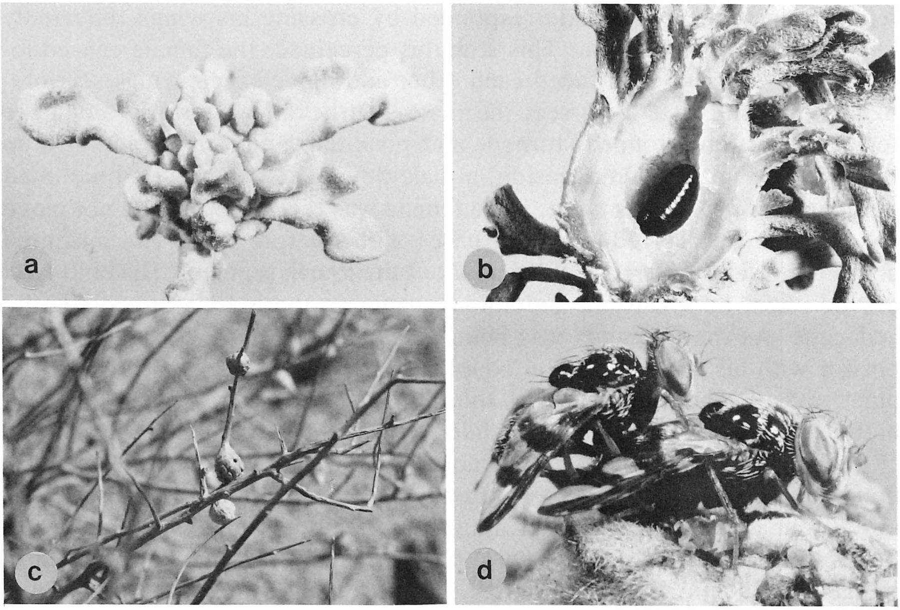

Fig. 1. *Procecidochares* sp. (a) young bud gall on *Ambrosia dumosa,* 4.4×, (b) mature gall in cross section containing puparium and showing exit tunnel, 3.3×, (c) old, empty, woody, persistent galls, 0.4×, (d) mating adults, 8.7×.

8–10 days after pupariation began. Following adult emergence, the walls of the empty galls hardened and darkened and the leaves thereon dried and abscised. Old galls persisted as permanent woody swellings that festooned the stems and branches of the repeatedly galled plants (Fig. 1c).

Adult.—Under both field and insectary conditions, males began their emergence 1–2 days before the females and they predominated during the early phase of the emergence period. Most emergence occurred during the morning hours. Males also consistently outnumbered females in field collections. The closest male:female capture ratio recorded was 2.1:1 for 160 adults aspirated in 1 hr during their peak field abundance in October, 1976. Wind speeds greater than 24 kph (15 mph) (measured with a hand-held Dwyer® wind meter at 1-m height) greatly curtailed adult activities and rendered their collection difficult. During such windy periods, most flies rested on sheltered branches inside the crowns of gall-bearing plants.

Mating was first observed on the fourth day after adult emergence began in the field; however, in the insectary, newly emerged adults attempted mating as soon as their exoskeletons became fully hardened and pigmented. In nature, males contacted females atop terminal foliage and branches, where the males waited with their bodies oriented horizontally. When a female approached, the male responded by crossing his wings repeatedly with a scissors-like motion. This stimulus perceived, the female ceased locomotion. The pair then faced each other and moved their wings scissors-like in unison. After 5–10 sec, the male swiftly ran posteriorly along the female's dorsum, stopped, turned, and positioned himself, headfirst atop the female (Fig. 1d). On occasion, a male flew over a female and mounted her from behind. At this point, if the female was receptive and did not move away, the male clasped her wing bases with his fore tarsi. His mid tarsi clasped the sides of her abdomen at about the fourth segment. His hind tarsi curved under her posterior abdominal segments and aided in uncoiling the aedaegus. As the aedeagus was being uncoiled, the male grasped the ovipositor with his claspers. Upon coupling, the male rested hind tarsi on the plant surface. During copulation, the female's wings were spread and held motionless at an angle of 45°, while the male's wings usually remained closed. Both sexes pumped their mouthparts continuously during copulation. Adults *in copula* rarely separated if disturbed. The pair usually moved away from an offending stimulus in tandem; however, they were never seen flying while paired. In the insectary, copulation lasted an average of 45 min (range: 28–71 min, N = 15). Mating was observed in the field in the early morning, at mid-day, and in the late afternoon; in the insectary, throughout the photophase.

Females first were observed ovipositing 3 days after they began to emerge in the field; however, in the insectary, 16 or 20 (80%) isolated females laid an average of 8 (range: 2–20) eggs 1 day after their emergence. Before ovipositing in nature, the female repeatedly probed a leaf axil on the flush, terminal branch growth with her ovipositor. The ovipositor usually was withdrawn after the deposition of a single egg; however, egg deposition did not always follow ovipositor insertion in accepted buds. After ovipositing, the female always moved to the next, proximal axil. She thus worked her way towards the base of the current branch growth, probing most nodes encountered until she reached the more woody portion of the branch. She then either walked back up the same branch and/or flew to another branch to begin this behavioral sequence anew.

Oviposition was observed in the field throughout the day and only occurred during the photophase in the insectary. Four days after their emergence in the insectary, 20 females provided with water, honey, and bouquets of freshly cut, terminal branches, deposited 90+% of their total egg production. Their oviposition periods lasted 6 or 7 days, during which time they produced an average total of 107 ± 35 (range: 38–166) eggs. One female laid 78 eggs during a 12-hr photoperiod. The average time required for 10 females to deposit an egg under field conditions was 3.5 ± 0.5 min.

In the insectary, the mean longevity of 20 males was 7 ± 1.4 (range: 5–

9) days; for 20 females, 7 ± 0.8 (range: 5–8) days. Capture records suggested that adults also live about 1 week in nature.

Seasonal history.—This tephritid species normally is bivoltine in southern California; however, univoltine reproduction, conceivably even biennial reproduction, may occur under certain conditions. This is because the resumption of gall and larval development depends on and coincides with the production of host-plant vegetative regrowth triggered by winter as well as late-summer/early-fall rainfalls. Should only one or neither of these rainfall periods locally produce enough moisture to stimulate and sustain host-plant growth, then local reproduction by *Procecidochares* sp. is likewise curtailed.

At our study site, first instars remained quiescent in galls for as long as 5 months, from mid-April to early September, 1976, during which time no rainfall occurred and *A. dumosa* remained dormant. Ten days after a heavy rainfall, most larvae had already reached the third instar in their rapidly growing galls.

Natural enemies.—The following parasitic Hymenoptera were reared from fully formed galls collected during 1970 and 1971 at various locations in southern California: Chalcididae—*Spilochalcis flavopicta* (Cresson); Eulophidae—*Aprostocetus* sp., *Tetrastichus* sp.; Eurytomidae—*Eurytoma* (2) spp.; Platygasteridae—*Platygaster* sp.; Pteromalidae—*Halticoptera stella* Girault, *Pteromalus* sp.; Torymidae—*Microdontomerus anthonomus* Crawford, *Torymus capillaceus capillaceus* (Hüber).

In addition, a jumping spider, *Pellenes signatus* (Banks) (Araneida: Salticidae), was observed feeding on adults at Palm Springs. Several full-sized, newly formed galls were observed that had been chewed open and the contents destroyed, apparently by rodents. Larvae of an undetermined species of Lepidoptera also were found within the developing galls feeding on the plant tissues and, occasionally, on the larvae of *Procecidochares* sp.

Interesting, though as yet unresearched, relationships were suggested by the *Apion* sp. (Coleoptera: Curculionidae) adults reared from current season's galls and the eggs of a large weevil (*Ophyrastes* sp.) found packed inside an old, weathered gall at Palm Springs.

Acknowledgments

The technical assistance of Mr. D. W. Ricker, Division of Biological Control, University of California, Riverside, is gratefully acknowledged. Our sincere thanks to Dr. G. Gordh, at the same address, and Drs. E. E. Grissell and P. M. Marsh, Systematic Entomology Laboratory, IIBIII, USDA, % U.S. National Museum of Natural History, Washington, D.C., for identifying the parasites. Dr. R. H. Foote, also at the Systematic Entomology

Laboratory, and F. L. Blanc, California Department of Food and Agriculture (retired), Sacramento, identified this fruit fly, as previously noted.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 289–292

ON TYPE SPECIMENS OF *AMPHIZOA* LECONTE (COLEOPTERA: AMPHIZOIDAE)

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The most recent taxonomic treatment of members of the beetle family Amphizoidae was Edwards' (1951) worldwide revision. He recognized five *Amphizoa* LeConte (1853:227) species—one Palaearctic and four Nearctic species, one of which (*Amphizoa carinata*) he described as new. Since then, a sixth species, *Amphizoa kashmirensis* Vazirani (1964:145), has been described from India.

Because of more restrictive institutional lending policies than at present and difficulty in visiting major museums across North America and in Europe, Edwards (personal communication) was unable to study type material for most of the *Amphizoa* species. Consequently, his revision contains data only for the type of *A. carinata* (Edwards, 1951:326). Further, reference to the original descriptions of all nine nominal species (including three junior synonyms) of *Amphizoa* indicates that lectotypes are needed for all but four (i.e. *A. carinata, A. planata,* and *A. striata* Van Dyke and *Dysmathes sahlbergii* Mannerheim) of these names.

The purpose of this report is (1) to provide data (including lectotype designations) for type specimens of *Amphizoa* nominal species which have been located to date and (2) to solicit help in locating the remaining type specimens and/or series. Publication of these data is also prerequisite for their inclusion in the forthcoming fascicle on Amphizoidae (Kavanaugh, manuscript in preparation) in "A Catalog of the Coleoptera of America North of Mexico" (J. M. Kingsolver, editor in chief).

Type Specimens of *Amphizoa* Nominal Species

Amphizoa carinata Edwards (1951:326). HOLOTYPE, a male, in California Academy of Sciences, San Francisco [CAS], labelled: "Monkhaven Col. VI-21-35"/"On Conejos River"/"Van Dyke Collection"/[blank card with left hindwing mounted]/"Holotype Amphizoa carinata Edwards" [red-tipped label]/"California Academy of Sciences Type No. 8130." Allotype also in CAS.

Amphizoa davidis Lucas (1882:157) [=*A. davidi* Lucas, emended by Wu (1933:335)]. Location of type specimen unknown.

Edwards, Vazirani (personal communication), and I have been unable to locate a specimen of this species in any of the major museums in North America or in Europe or Asia. It is therefore not possible to determine at present if, in fact, this taxon is actually related to the Nearctic Amphizoidae. Because Lucas' original description gives no clue to the number of specimens he examined, and in the event that a type specimen or series is eventually relocated, a lectotype should be designated.

Amphizoa insolens LeConte (1853:228). LECTOTYPE (here designated), a male, in Museum of Comparative Zoology, Cambridge, Massachusetts [MCZ], labelled: [gold disk]/"Type 5969" [red label]/"Amphizoa insolens *Lec.*"/"Lectotype Amphizoa insolens LeConte designated by D. H. Kavanaugh 1979" [red label]. One paralectotype female also in MCZ.

LeConte's original series apparently included five specimens (LeConte, 1853:228). However, only two specimens likely to have been part of that series have been located at MCZ (A. F. Newton, personal communication).

Amphizoa josephi Matthews (1872:119) [=*A. insolens* LeConte]. LECTOTYPE (here designated), a male, in British Museum (Natural History), London [BMNH], labelled: "Type" [red-trimmed disk]/"Matthews coll. 1904-120."/"Amphizoa josephi" [horizontal inked line traversing the label] "Vancouvers-I-" [yellow label]/"Amphizoa josephi, Matthews. Type mihi, D.S."/"Lectotype Amphizoa josephi Matthews designated by D. H. Kavanaugh 1979" [red label].

Although the type series presently consists of a single specimen, a lectotype is here designated because Matthews' original description gives no indication of the number of specimens he studied.

Amphizoa kashmirensis Vazirani (1964:145). HOLOTYPE, a male, in Zoological Survey of India Collection, Calcutta.

I have not yet studied the type specimen [see Vazirani (1964:145) for specimen data], nor have I seen other specimens referable to this species. Therefore, I am not yet certain that this species belongs in genus *Amphizoa* or even in Amphizoidae.

Amphizoa lecontei Matthews (1872:121). LECTOTYPE (here designated), a male, in BMNH, labelled: "Matthews coll. 1904-120."/"Amphizoa lecontei" [horizontal inked line traversing the label] "Vancouvers-I." [yellow label]/"Lectotype Amphizoa lecontei Matthews designated by D. H. Kavanaugh 1979" [red label].

A lectotype is here designated for the same reason as for *A. josephi* above.

Amphizoa planata Van Dyke (1927a:98) [=*A. lecontei* Matthews]. HOLOTYPE, a female, in CAS, labelled: "Beaver Cr. Alta" [date illegible] "F. S. Carr"/"Van Dyke Collection"/"Holotype Amphizoa planata Van Dyke" [red-tipped label]/"=Amphizoa lecontei Matth."/"California Academy of Sciences Type No. 2453."

Amphizoa striata Van Dyke (1927b:197). HOLOTYPE, a male, in CAS, labelled: "Northbend King Co. Wsh. VII-11-1920"/"Coll. by E. C. Van Dyke"/"Van Dyke Collection"/"Holotype Amphizoa striata Van Dyke" [red-trimmed label]/"California Academy of Sciences Type No. 2463."

Dysmathes sahlbergii Mannerheim (1853:265) [=*A. insolens* LeConte]. Originally described as a genus in family Tenebrionidae. Location of type specimen unknown.

According to his original description, Mannerheim studied only one specimen of *D. sahlbergii* which, therefore, is the holotype. However, no specimen identified as belonging to this taxon has yet been found in the Mannerheim Collection at Universitetets Zoologiska Museum Entomologiska Avdelningen, Helsingfors [UZMH] (H. Silfverberg, personal communication).

Acknowledgments

I thank A. F. Newton (MCZ) and M. E. Bacchus (BMNH) for lending type material in their care to me for study, and H. Silfverberg (UZMH) for his efforts on my behalf in searching through the Mannerheim Collection.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, p. 292

SCIENTIFIC NOTE

SWARMING OF *LEUCORRHINIA HUDSONICA* (SELYS) (ODONATA: LIBELLULIDAE)

On 10 July, 1978 at about 1300 hr, immediately after a thunderstorm, we saw what we believe was an unusual swarm of *Leucorrhinia hudsonica* (Selys). This swarm occurred on a partially shaded dirt road (Grassy Lake Rd.) which runs west from Hwy 89 between Yellowstone and Grand Teton National Parks. At about 5–6 km from the intersection, the road approaches the south edge of a large marsh, and there several hundred *Leucorrhinia* were flying up and down in such a way that the space above the road seemed to be undulating, although the individual dragonflies were not in synchrony. Of those collected, none were teneral, and most were males. However, several mating pairs were observed. Occasionally an individual dragonfly would land briefly on the road, or on top of our car, or in one of the lodgepole pines beside the road, but most remained in the air. No other odonate species were seen and there were no swarms of midges or other small insects over the road. The swarm extended along the road for about 200 m, and up to a height of 3–4 m.

On 10–11 July 1979, we returned to this site, but did not observe a swarm such as we had seen the year before, perhaps because the season was earlier. However, we did observe, between 1800 and 1900 hr, feeding flights along the edge of the marsh near the road. *Leucorrhinia,* as well as other species of different genera, were feeding on midges, as has been described by Corbet (1962, *Biology of Dragonflies,* pp. 151–154) and others.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 293–296

A NEW *PSEUDEVOPLITUS* RUCKES FROM GUATEMALA WITH A KEY TO THE SPECIES (HEMIPTERA: PENTATOMIDAE)[1]

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A recent trip to Guatemala resulted in the collection of 5 specimens of an undescribed pentatomid assignable to the genus *Pseudevoplitus* Ruckes, 1958. *Pseudevoplitus* superficially resembles *Evoplitus* Amyot & Serville, 1843, but differs by having the tip of the scutellum entire versus emarginate, and in having a shorter ostiolar sulcus. Additional characters for diagnosing this genus are given by Ruckes (1958) but include most importantly the structure of the thoracic and abdominal sterna. In *Pseudevoplitus* the mesosternal carina is very prominent, broadly contiguous with the metasternum posteriorly and compressed into a crest reaching between the procoxae anteriorly. The metasternum is elevated and notched behind to receive the anteriorly directed spine of the third abdominal segment. The abdominal venter is obtusely, longitudinally keeled mesially.

Pseudevoplitus now contains 3 species: the genotype *P. paradoxus* Ruckes, 1958, found in Peru, *P. longicornis* Ruckes, 1959, which occurs in Panama and Costa Rica, and the new species described below. These 3 species can be separated by the key provided below following the description of the new species, and by features of the male genitalia figured by Ruckes (1958, 1959) and accompanying this description.

Pseudevoplitus casei, new species
(Figs. 1–4)

Ovate; dorso-ventrally compressed. Overall color brownish-gray, mottled with dark patches of pigment on prothorax, scutellum and corium; matte dorsally, semi-glossy ventrally. Dorsum and thoracic venter with dense, black to dark brown punctations. Abdominal venter with shallower, less dense, castaneous punctations. Head, measured from base of ocelli to tip of tylus, longer than intraocular width (ratio 9:7). Anteocular margins strongly sinuate, weakly reflexed and thinly margined with castaneous pigment. Tylus slightly elevated above the plane of the disc; tips of jugae convergent and contiguous; disc evenly, castaneously punctate. Ocelli light red; eyes reddish-brown, somewhat protuberant. Antennae long, total length more than 80% of the total body length; segment I exceeding apex

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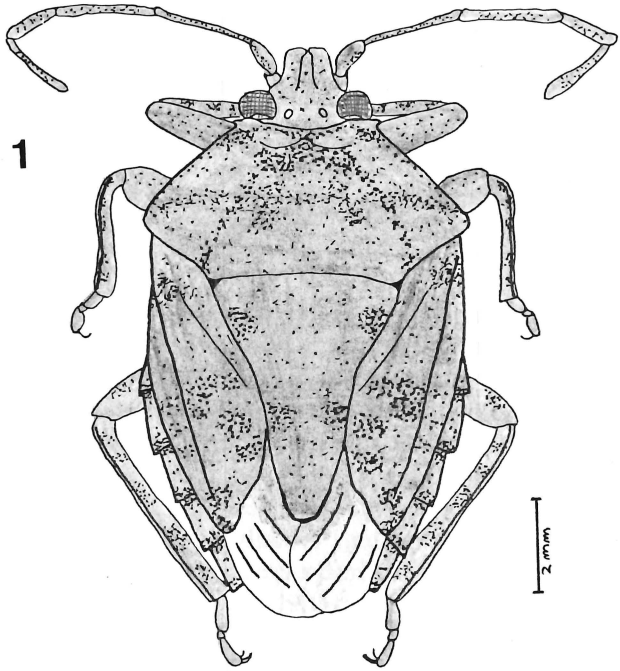

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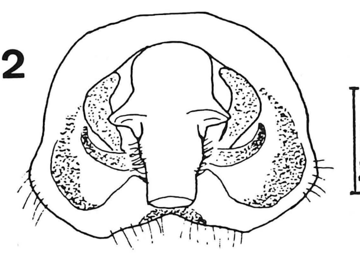

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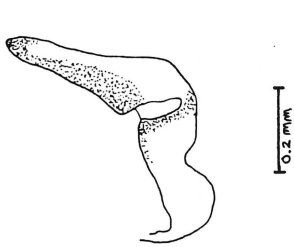

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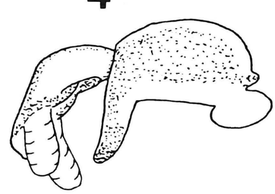

Figs. 1–4. *Pseudevoplitus casei* Thomas n. sp.: Fig. 1, dorsal aspect; Fig. 2, caudal view of male genital capsule; Fig. 3, ental view of right paramere; Fig. 4, lateral view of aedeagus.

of head; segmental ratios 9:23:23:29:23, i.e. segment I shortest, IV longest, II, III and V subequal; segments infuscated except for short distance at base and apex of segments II through V pale. Rostrum of moderate length, nearly or just attaining base of abdominal setment III in repose; rostral segment II arcuate in lateral view in apposition to mesosternal crest. Bucculae evanescent posteriorly. Thorax convex dorsally; more than twice as wide across the humeri than long mesially; anterolateral margins straight and distinctly reflexed, the reflexion terminating abruptly at humeri; posterior margin of pronotum mildly concave. Pronotal punctations densest on either side just posterior to cicatrices. Scutellum longer mesially than wide basally (ratio 10:8); apical half feebly concave; tip bluntly acuminate, margined with black; basal angles subfoveolate, black. Apex of corium sinuate, lateral margin reflexed anteriorly; surface with punctations coalescing forming blotches on disc of corium and apical portions of embolium. Membrane darkly infuscated basally becoming hyaline apically except veins which are distinguished in the middle portion of their length as brown streaks. Connexivum broadly exposed; alternately blotched at the angles, maculated thickly between blotches. Prosternum with obtuse, broadly V-shaped carina, the notch of the V hidden by the mesosternal crest, the arms of the V paralleling the propleural border and reaching behind eyes. Mesosternum and metasternum as characteristic of the genus: mesosternum either side of carina sparsely to moderately hirsute. Metasternal scent gland canal moderately wide, elevated from pleural surface, curving anteriorad, reaching ⅔ distance from orifice to pleural margin. Evaporative surface matte, fuscous, mottled with black. Femora maculate; tibia with alternate, castaneous blotches; superior surface narrowly but distinctly sulcate. Abdominal venter bearing anteriorly directed, spinose tubercle on segment III (2nd visible), the tubercle continued posteriorly as a longitudinal, obtuse, mesial keel ornamented with a dark brown, mesial vitta. Ventral abdominal surface semi-glossy, maculate, each maculation bearing a short seta. Spiracles with thin, piceous ring. Connexival apices and lateral abdominal margin just posterior to apices blotched with black. Male pygophore (Fig. 2) broadly open dorso-posteriorly. Posterior border nearly obsolescent mesially (prominent, entire in *P. longicornis*); inferior margin armed by a pair of broad, blunt cusps, forming a mesial cleft between them, this cleft subtended ectally by a shallow, mesial concavity; much smaller than the mesial concavity of *P. longicornis*. Head of parameres terete, elongate, black, the tips bluntly acuminate (Fig. 3). Phallotheca of aedeagus bearing a prominent, elongate, mesial horn (Fig. 4). Female 2nd gonocoxites large, quadrate, contiguous mesially, the surface strigose basally, granulate apically. Holotype: Male, 11.5 mm long, 6.7 mm wide across the humeri. Guatemala, Jutiapa Province, Cañon de Monjoy; 27 July 1979. E. P. Case and D. B. Thomas, collectors. Deposited in the United States National Museum.

Allotype.—Female, 12.6 mm long, 7.3 mm wide across humeri. Same locality, date and collectors as holotype. Deposited in United States National Museum.

Paratypes.—Males (3). All same locality, date and collectors as holotype. Deposited in the author's collection.

Derivation of epithet.—Named for botanist, companion and co-collector of the type series, Elizabeth P. Case of the University of Missouri–Columbia.

Comments.—*Pseudevoplitus casei* is clearly closely allied to *P. longicornis* from Costa Rica, as evidenced by the overall morphology, but especially by the form of the genitalia. The principal differences between these 2 species being the relative size of the submedial cusps on the inner margin of the pygophore and its subtendant concavity. The new species is more distantly related to the genotype *P. paradoxus* from Peru, particularly with respect to the form of the male pygophore and proctiger. While this difference might support a subgeneric distinction for *P. casei* and *P. longicornis*, a nominal separation would seem unnecessary since the genus contains only 3 species. In their major morphological features, in particular the form of the ventral armature, the 3 species are in conformity.

Key to the Species of *Pseudevoplitus* Ruckes

1. Pronotal humeri produced, cornute. Peru .... *paradoxus* Ruckes
   Pronotal humeri not produced, entire. Central America 2
2. Rostrum long, attaining abdominal segment V in repose .... *longicornis* Ruckes
   Rostrum shorter, not exceeding abdominal segment III in repose .. .. *casei*, n. sp.

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Footnote

[1] Contribution from the Missouri Agricultural Experiment Station. Journal Series No. 8456.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 297–310

A REVIEW OF THE GENUS *THRINCOPYGE* LECONTE (COLEOPTERA: BUPRESTIDAE)[1]

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The genus *Thrincopyge* has 3 known species and belongs to the monogeneric tribe Thrincopygini. The last treatment was by Kerremans (1907). Since that work is not readily available and more information has become available, a review of the genus is in order. Only the more important citations are listed under the genus and species. The type locality for each species is given as it appears in the original publication, and any additional information is placed in brackets.

Unless otherwise indicated, specimens are in the collector's collection. Abbreviations for collections [brackets] are as published in Arnett and Samuelson (1969). The following were not included in that work: W. F. Barr collection = WFBC; British Museum (Natural History) = BMNH; Narodni Museum, Prague = NMPC; and D. S. Verity collection = DSVC. My name is abbreviated GHN.

Biology

The larvae of *Thrincopyge* work in the dead flower stalks of *Dasylirion* spp., Fig. 1, and *Nolina* spp. [*T. ambiens* (LeC.)] (Agavaceae), and adults of all 3 species have been collected on *Dasylirion* spp. Larvae mine the interior of stalks and pupate there. Adults emerge from March to September and can generally be found at the bases of the leaves, where they usually sit facing upward. It is helpful to have long forceps to collect the adults if they are on *Dasylirion* spp., which have hooks along the margins of the leaves. Suspicions that adults feed on the leaves of the host plants were confirmed when D. S. Verity collected live adults of *T. ambiens* and *T. alacris* LeConte from Arizona and New Mexico and kept them alive for 2 weeks. During that time he reported (in litt.) that they fed voraciously on young leaves of *Dasylirion* sp. and *Nolina* sp. They made notches along the margins, sometimes cutting completely through the leaf, causing the distal part to drop. Efforts were unsuccessful to get oviposition in the basal flower stalk of a *Dasylirion* sp. that had recently bloomed. Frank Parker reported (in litt.) that he has observed *T. ambiens* feeding on the edges of leaves and inside the center leaf bundle of *Nolina* sp. in Arizona, including in winter. This indicates the adults might live more than 1 season.

Geographical Distribution

This genus occurs in the southwestern United States and northern Mexico. *T. ambiens* and *T. alacris* are known from Arizona, New Mexico, Texas, and northern Mexico, with *alacris* extending south to Puebla. *Thrincopyge marginata* Waterhouse is recorded from Durango and Jalisco.

Family Buprestidae
Subfamily Thrincopyginae
Tribe Thrincopygini

Tribe Thrincopygini LeConte, 1861:154; LeConte & Horn, 1883:198; Kerremans, 1902:44; 1907:595.

Distinctive features of the monogeneric tribe Thrincopygini include: body elongate, depressed; poriferous area of antennal segments on inner surface and inferior margin toward apex; mesosternum emarginate but not divided; metacoxae dilated medially; last visible abdominal sternite with deep sulcus around margin of apical half; tarsal claws simple.

Genus *Thrincopyge* LeConte

Thrincopyge LeConte, 1858:17; 1860:219; 1861:154; LeConte & Horn, 1883:198; Horn, 1885:146; Kerremans, 1900:307; 1902:44; 1907:595; Burke, 1917a:6; Chamberlin, 1926:240; Arnett, 1960:483.

Body elongate, parallel-sided, depressed above, convex below.

Head convex; foveae for antennal insertion small and widely separated; clypeus shallowly arcuately emarginate; mentum corneous; antennae with segment 1 clavate, twice as long as 2, segment 3 one-half longer than 2, segments 4 to 11 subequal in length to 2, serrate from 5 and with poriferous area on internal surface and inferior margin toward apex of each segment; eyes small, oval.

Pronotum wider than long; disk convex, depressed in midline toward base; sulcus along lateral margin basally; scutellum small, distinct.

Elytra with disk moderately flattened, with rows of punctures; lateral margins sulcate; apex serrate-truncate.

Prosternum broad, with anterior margin feebly arcuately emarginate, lateral sutures oblique; prosternal process with fine sulcus along lateral margin, apex obtusely rounded, enclosed by mesosternum; mesosternum emarginate, not divided; meso-metasternal suture entire and straight; metacoxae dilated medially, with anterior margin sinuate, posterior margin oblique; tibiae straight, unarmed; protibia with brush of setae on inner margin at apex, Fig. 9; metatibia with similar brush along outer border, Fig. 10; tarsi broad, segments subequal in length, claws small, simple.

Abdomen convex, not sulcate; sternite 1 distinctly longer than either sternites 2, 3, or 4; sternite 5 narrowly rounded or slightly truncate at apex in female, Fig. 7, or broadly rounded to truncately rounded in male, Fig. 8, both with distinct sulcus around inside of apical half, producing deflexed margin.

Type species.—Buprestis ambiens LeConte, designated by Chamberlin, 1926:240.

Comparisons.—Thrincopyge is the only genus in the subfamily *Thrincopyginae* and has no known close relatives. Chalcophorinae and Buprestinae, which also have the metacoxae dilated medially are nearest, but *Thrincopyge* differs from genera in those subfamilies in the following features: body elongate depressed; mesosternum emarginate, not divided; last visible abdominal sternite with deep sulcus around margin of apical half. Features mentioned as distinctive under the tribe Thrincopygini also serve to distinguish the genus.

Immature Stages

Larva.—Records of the immature stages of this genus were based on larval studies of *T. ambiens* by Burke (1917a:6, Pl. 4, Fig. 3) as follows: first thoracic segment distinctly larger and broader than segment 2; dorsal and ventral plates of segment 1 rather small, oval, without distinct chitinous rugosities and marked by distinct brownish median sulcus which is enlarged in front and forked behind; median subdorsal areas of thoracic segments 2 and 3 with pair of brown spots; last abdominal segment narrowed and bilobed, without chitinous fork at apex.

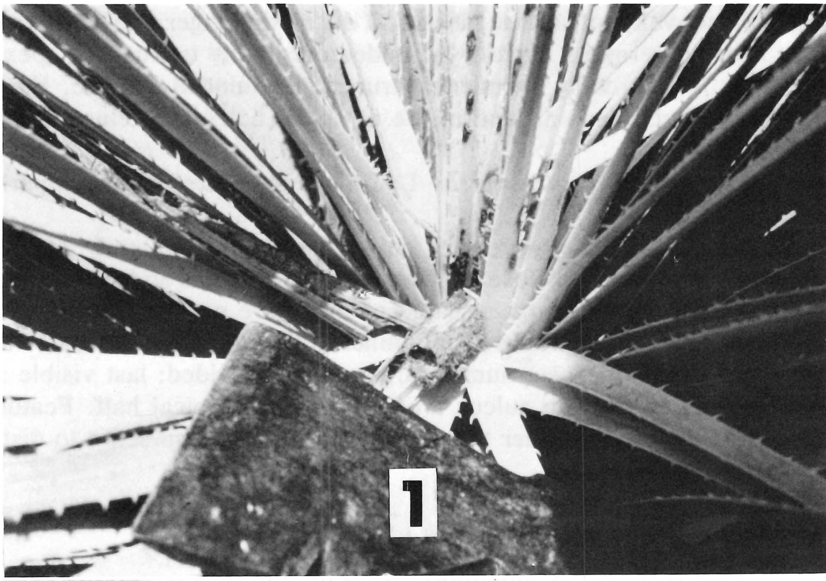
Three larvae of what are possibly *T. alacris* were collected in Texas, Val Verde Co., near Sanderson, 2 July 1972, R. L. Westcott, in *Dasylirion* sp. They are similar to the above description but lack the brown spots on thoracic segments 2 and 3.

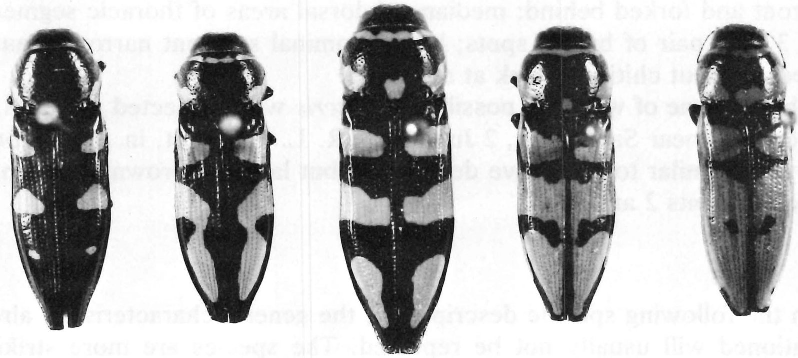
Adults

In the following specific descriptions, the generic characteristics already mentioned will usually not be repeated. The species are more strikingly different in their color patterns than they are in external structure and these color differences usually readily distinguish them. The male genitalia are distinctive in the 3 species.

Key to the Species of *Thrincopyge*

1. Pronotum with yellow markings, at least along lateral margins 2
   Pronotum immaculate, occasionally with red-orange along lateral margins 3





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Figs. 1–2. Fig. 1, plant of *Dasylirion wheeleri* Watson showing the workings of *Thrincopyge ambiens* (LeConte) in the flower stalk. Photo taken by H. F. Howden, near Portal, Arizona. Fig. 2, adult *T. alacris* LeConte, showing variations in color pattern.

2. Yellow markings usually as spots on elytra and usually along lateral, anterior, and/or posterior margins of pronotum; punctures of pronotum and elytra small and sparse, Fig. 2; male genitalia, Fig. 11 .... 1. *alacris* LeConte
   Yellow markings confined to lateral margin of pronotum and elytra; punctures of pronotum and elytra larger and denser, Fig. 4; male genitalia, Fig. 12 .... 2. *ambiens* (LeConte), typical form
3. Elytra immaculate, Fig. 5 ... 2. *ambiens* (LeConte), immaculate form
   Elytra margined with red-orange, Fig. 6 ... 3. *marginata* Waterhouse

1. *Thrincopyge alacris* LeConte
(Figs. 2, 11)

Thrincopyge alacris LeConte, 1858:17; 1860:219, Pl. 11, Fig. 2; Waterhouse, 1882:19; Kerremans, 1900:308; 1907:598; Good, 1925:272, Figs. 32, 33 (wing venation).
Thrincopyge alacris var. *strandi* Obenberger, 1936:104 (**NEW SYNONYM**).

Diagnosis.—Blue or greenish blue above and below with yellow markings as follows: on pronotum along lateral margins, usually along anterior margin and as midline spot along basal margin; on elytra as transverse spots at basal fourth, as transverse spot at middle and as elongate spot in apical third, variably reduced; ventrally on metacoxae and sometimes on first and second abdominal sternites; punctures of pronotum and elytra fine and sparse; elytral striae not evident.

Male.—Head glabrous, front coarsely punctate and rugose, punctures more sparse toward vertex.

Pronotum with anterior margin straight; posterior margin bisinuate; lateral margins parallel at base then arcuately expanding to widest at middle and converging to narrowest at anterior angles; disk glabrous, convex, surface finely chagreened with fine sparse punctures; shallow sulcus along basal margin and posterior three-fourths of lateral margins. Scutellum cordate.

Elytra sinuately parallel on anterior two-thirds, then converging to apices; disk glabrous, flattened, with rows of fine punctures not deeply impressed, and sulcate along lateral margins.

Ventrally: thoracic sternites moderately densely punctate laterally, sparse medially; prosternal process convex with fine lateral sulcus evident, surface with few elongate punctures; meso- and metasterna flattened in midline; abdominal sternites convex; punctures very fine and sparse toward middle, larger and more dense laterally; fifth sternite with apex broadly rounded, with deep sulcus around apical half producing deflexed margin; femora moderately robust, sparsely punctate; tibiae more coarsely punctate; protibia with dense brush of setae on inner margin at apex; metatibia with similar brush along outer border.

Male genitalia, Fig. 11.

Length 21.5 mm; width 6.7 mm.

Redescribed from a male homotype from Arizona, Gila Co., near Globe, Sixshooter Canyon, 18 August 1961, GHN, on *Dasylirion wheeleri* Watson.

Female.—Differs from male in having last visible abdominal sternite more elongate and more narrowly rounded at apex.

Variation.—The males vary in size from 16.5 to 22.0 mm long and from 5.2 to 7.2 mm wide; the females from 16.5 to 22.5 mm long and from 5.5 to 7.2 mm wide. This species exhibits a highly variable color pattern ranging from predominantly blue with yellow only along lateral margins of pronotum with no elytral spots to the common pattern of large yellow spots, or predominantly yellow (Fig. 2). The variety *strandi* was based on a specimen in which the yellow color predominates. Of the 10 specimens in the LeConte collection [MCZC] 9 have the background color purplish black, probably resulting from discoloration. Those seen from Coahuila, Mexico are more greenish than blue.

Type locality.—Of *alacris,* "Arizona," lectotype female [MCZC, LeConte collection]; of *strandi,* "Texas," type [NMPC].

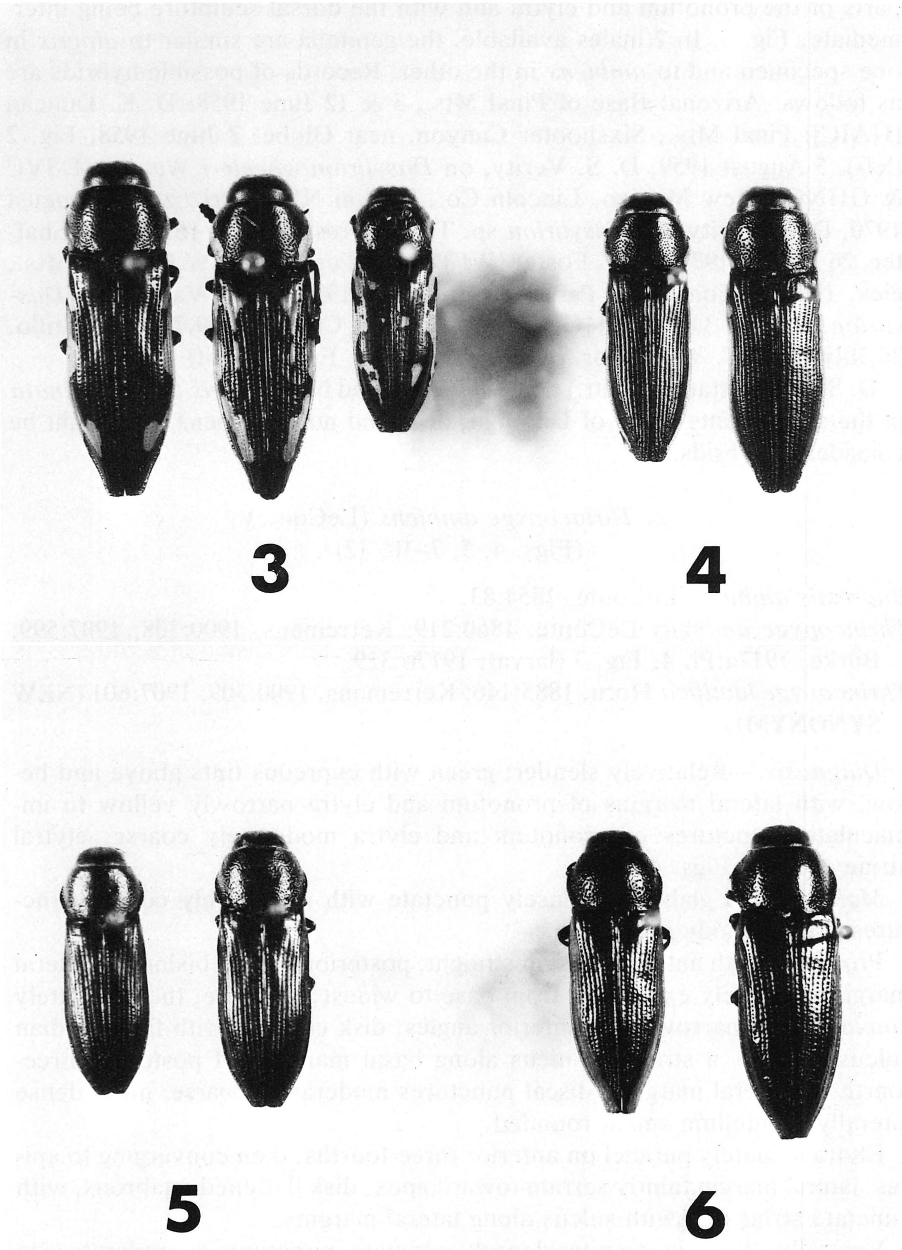
When LeConte described *alacris* he mentioned 1 specimen from Arizona and numerous specimens from New Mexico. There are 10 specimens in his collection and 9 of these are marked with dark green disks, indicating New Mexico. One female labelled as follows: silver disk [indicating Arizona]/red label with "Type 2713"/white label with handwritten "Thrincopyge alacris Lec.," is here designated as the lectotype. The others, numbered 2 through 10 (including 5 males and 4 females) are labelled as paralectotypes.

Geographical distribution.—UNITED STATES: Arizona, New Mexico, and Texas. MEXICO: Chihuahua, Coahuila, Durango, Guanajuato, Jalisco, Puebla, and Zacatecas. **New state record**: San Luis Potosi, Matehuala, 23 September 1976, J. A. Chemsak, A. & M. Michelbacher [CISC].

Hosts.—Recorded from flower stalks of *Dasylirion wheeleri* Watson (Chamberlin, 1926); also, Texas, Big Bend Nat. Park, May 1959, H. F. Howden, E. C. Becker, working in flower stalks of *Dasylirion leiophyllum* Englemann (**New host record**). Adults have been taken from 5 March to 12 August.

Comparisons.—The usual color pattern for *alacris,* deep blue with yellow spots, is distinctive. The other species are more greenish and any dorsal markings are confined to the lateral margins. Occasional specimens have the yellow markings reduced, but the punctures of the pronotum and elytra are smaller and on the pronotum sparser in *alacris* than in the other 2 species.

A few specimens have been taken among mixed populations of *alacris* and *ambiens* that are possibly hybrids of the 2 species with the general facies of *alacris* but with the yellow markings more confined to the lateral



Figs. 3–6. Fig. 3, three adults of possible hybrids between *Thrincopyge alacris* LeC. and *T. ambiens* (LeC.). Fig. 4, adult *T. ambiens* (LeC.), typical color pattern, male left, female right. Fig. 5, adult *T. ambiens* (LeC.), immaculate form, male left, female right. Fig. 6, adult *T. marginata* Waterhouse, male left, female right.

parts of the pronotum and elytra and with the dorsal sculpture being intermediate, Fig. 3. In 2 males available, the genitalia are similar to *alacris* in one specimen and to *ambiens* in the other. Records of possible hybrids are as follows: Arizona: Base of Pinal Mts., 3 & 12 June 1958, D. K. Duncan [UAIC]; Pinal Mts., Sixshooter Canyon, near Globe, 7 June 1958, Fig. 2 (left), 5 August 1959, D. S. Verity, on *Dasylirion wheeleri* Watson [DSVC & GHNC]. New Mexico, Lincoln Co., 9.7 km NW Carrizozo, 24 August 1970, D. S. Verity, on *Dasylirion* sp. Texas: Presidio Co., 16.1 km N Shafter, 26 August 1971, D. E. Foster [WFBC]; El Paso Co., NW Franklin Mts., elev. 1371 m, Tom Mays Park, 26 September 1975, A. R. Valdez, on *Dasylirion* sp., Fig. 3 (middle) [GHNC]. MEXICO, Coahuila, 29.7 km S Saltillo, 26 July 1975, T. W. Taylor, on *Dasylirion* sp., Fig. 3 (right) [GHNC].

D. S. Verity stated (in litt.) that while he found both *alacris* and *marginata* in the same plants south of Durango, he found no specimens that might be considered hybrids.

2. *Thrincopyge ambiens* (LeConte)
(Figs. 4, 5, 7–10, 12)

Buprestis ambiens LeConte, 1854:83.

Thrincopyge ambiens LeConte, 1860:219; Kerremans, 1900:308; 1907:599; Burke, 1917a:Pl. 4, Fig. 3 (larva); 1917b:329.

Thrincopyge laetifica Horn, 1885:146; Kerremans, 1900:309; 1907:601 (**NEW SYNONYM**).

Diagnosis.—Relatively slender; green with cupreous tints above and below, with lateral margins of pronotum and elytra narrowly yellow to immaculate; punctures of pronotum and elytra moderately coarse; elytral striae evident, Figs. 4, 5.

Male.—Head glabrous, densely punctate with moderately coarse punctures; front weakly rugose.

Pronotum with anterior margin straight; posterior margin bisinuate; lateral margins obliquely expanding from base to widest at middle, then arcuately converging to narrowest at anterior angles; disk convex, with faint median sulcus at base, a stronger sulcus along basal margin and posterior three-fourths of lateral margins; discal punctures moderately coarse, more dense laterally. Scutellum small, rounded.

Elytra sinuately parallel on anterior three-fourths, then converging to apices, lateral margin faintly serrate toward apex; disk flattened, glabrous, with punctate striae and with sulcus along lateral margins.

Ventrally: thoracic sternites densely punctate, punctures of moderate size laterally, very fine and sparse medially; prosternal process feebly convex with fine distinct sulcus along lateral margin, surface with punctures fine and sparse; meso- and metasterna flattened and feebly concave toward midline; abdominal sternites convex, punctures fine and sparse toward midline and also along posterior margins of sternites 1–4, becoming larger and dense laterally; fifth sternite with apex truncately rounded, with deep sulcus around apical half producing pronounced deflexed margin, Fig. 8; femora moderately robust; protibia with dense brush of setae on inner margin at apex, Fig. 9; metatibia with similar brush along outer border, Fig. 10.

Male genitalia, Fig. 12.

Length 17.5 mm; width 5.7 mm.

Female.—Differs from male in having last visible abdominal sternite more elongate and narrowly rounded at apex, Fig. 7.

Length 20.0 mm; width 6.0 mm.

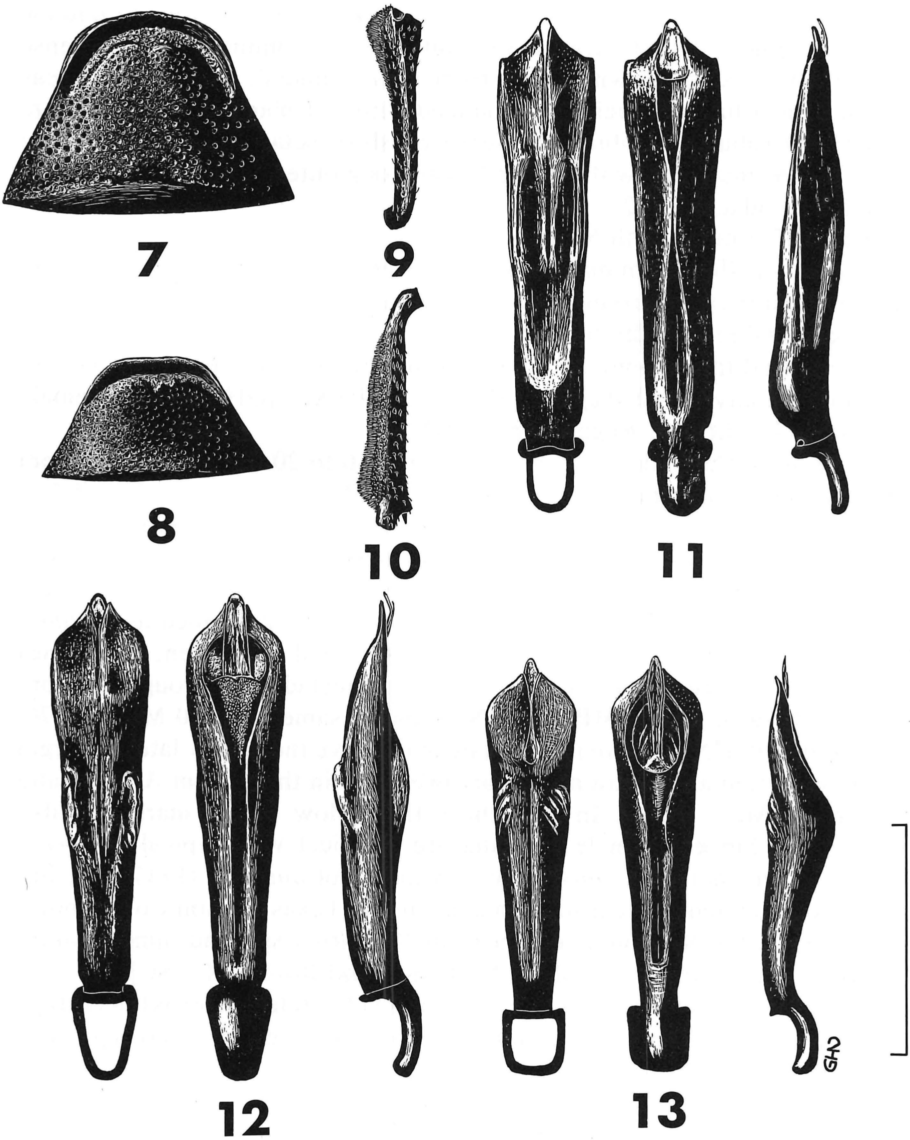
Redescribed from homotypes: male from Arizona, Gila Co., near Globe, Sixshooter Canyon, 30 August 1959, F. H. Parker [GHNC]; and female from same locality, 18 August 1961, GHN.

Variation.—The males vary in size from 15.0 to 20.0 mm long and from 5.0 to 6.5 mm wide; the females from 16.2 to 22.5 mm long and from 5.2 to 7.5 mm wide. The color varies from the more common green with cupreous tint to almost totally cupreous in some, blue-green in others, and occasionally the upper surface is almost black. Occasional specimens have a yellow spot or spots ventrally. Immaculate specimens were described as *laetifica* Horn and until recently no color intermediates had been seen. In a series of 9 collected in Texas, Val Verde Co., near Amistad Dam, Rough Canyon, 5–9 March 1979, Mel [UMRM, GHNC] and 1, same area, 20 March 1976, B. G. Beyer [GHNC], 2 are immaculate and 8 have the yellow lateral margin of the pronotum and elytra much narrower than in those from Arizona and the Chisos Mts., Texas. In 6 of these the yellow elytral margin is also interrupted. Since the male genitalia are identical with typical *ambiens, laetifica* Horn should be considered a synonym of *ambiens* (LeConte). Immaculate specimens have also been collected in Texas, Sutton Co., Sonora, 17 June 1968, GHN, dead at leaf bases of *Dasylirion* sp.; and same locality, 10 April 1950, Beamers, Stephan, Michener, and Rozens [CASC].

Type locality.—Of *ambiens,* "Frontera (Rio Grande)" [Texas], lectotype female [MCZC, LeConte collection]; of *laetifica,* "Texas," lectotype male [MCZC, Horn collection].

There are 3 specimens of *ambiens* in the LeConte collection [MCZC], 2 of which are labelled "Ariz." One female, 17.0 mm long, labelled as follows: dark red disk [Texas]/red label with "Type 2714"/white label with handwritten "T. ambiens Lec.," is evidently the one referred to in the original description as from "Frontera (Rio Grande)" and is here designated as the lectotype. As indicated in the original description, it lacks antennae, palpi, left middle leg, right hind leg and all tarsi. It is not certain that the other 2 were before LeConte when this species was described.

There are 2 male specimens of *laetifica* in the Horn collection from which



Figs. 7–13. Figs. 7–10, *Thrincopyge ambiens* (LeC.). 7) last visible abdominal sternite, female. 8) last visible abdominal sternite, male. 9) right protibia. 10) left metatibia. Fig. 11, *T. alacris* LeC., male genitalia, dorsal, ventral, and lateral views. Fig. 12, *T. ambiens* (LeC.), male genitalia, dorsal, ventral, and lateral views. Fig. 13, *T. marginata* Waterh., male genitalia, dorsal, ventral, and lateral views. (Line = 3 mm).

he evidently made the original description. One of these, here designated and labelled as lectotype, bears the following labels: white label with "Tex"/ white label with "♂"/green label with "PARATYPE, 3500." This specimen is 16.0 mm long, as indicated in the original description, and 5.2 mm wide. The second specimen, here designated and labelled as paralectotype, bears the following labels: first 2 labels as on lectotype/third label, red with "LECTOTYPE, 3500"/fourth label, white with *T. laetifica* Horn. This specimen is 16.5 mm long and 5.2 mm wide. Many specimens in the Horn collection bear "lectotype" labels that have never been validated. In this case, and possibly in others, the lectotype label may have been wrongly applied.

Geographical distribution.—UNITED STATES: Arizona, New Mexico, Texas. MEXICO: Coahuila. One specimen [USNM] bears labels "CA" and "Shoemaker Coll." Its occurrence in California has not been verified.

Hosts.—Larvae recorded from *Dasylirion wheeleri* Watson by Burke (1917b). Its occurrence in *Yucca,* reported by Chamberlin (1926), has not been verified. Adults have been taken many times in various parts of SE Arizona on *D. wheeleri.* Other records include Arizona: Gila Co., 12.9 km E Superior, 31 May 1958, GHN; Pinal Mts., Sixshooter Canyon, near Globe, 30 August 1959, F. H. Parker [GHNC]; Icehouse Canyon, near Globe, 31 May 1958, GHN, on *Nolina microcarpa* Watson; Mojave Co., Hualapai Mts., Hualapai Mt. Park, 27 July 1974, GHN, on *Nolina bigelovii* (Torrey) Watson. Texas, Big Bend Nat. Park, Green Gulch, 1615 m, 8 May 1959, Howden & Becker [CNCI, GHNC]; Big Bend Nat. Park, Chisos Mts. Basin, 24 June 1963; 21 June 1965, GHN, both dates on *Dasylirion leiophyllum* Englemann. **(New adult host records)**

Comparisons.—*T. ambiens* is compared with *T. alacris* under that species and differs from *T. marginata* as follows: body more slender than in *marginata*; lateral margins of elytra begin converging more apically and are less sinuate toward apices; pronotum typically with yellow lateral margins, immaculate in *marginata*; and elytra typically with yellow lateral margins, red-orange in *marginata.*

3. *Thrincopyge marginata* Waterhouse
(Figs. 6, 13)

Thrincopyge marginata Waterhouse, 1890:218; Kerremans, 1907:600.
Thrincopyge magnifica Kerremans, 1900:309 [erroneous name for *marginata*].

Diagnosis.—Relatively robust; blue-green above and below, with lateral borders of elytra broadly margined by red-orange and ill-defined red-orange spots along midline of sternal areas; punctures of pronotum and elytra moderately coarse; elytral striae evident.

Male.—Head glabrous, coarsely densely punctate, front rugose.

Pronotum with anterior margin straight; posterior margin bisinuate; lateral margins obliquely expanding from base to widest at middle, then arcuately converging to narrowest at anterior angles; disk strongly convex with midline sulcus basally, basal margin with sulcus and posterior three-fourths of lateral margins with strong sulcus; discal punctures coarse and sparse medially, denser laterally. Scutellum small, rounded.

Elytra sinuately parallel on anterior two-thirds, then converging to truncate apices, lateral margins toward apex faintly serrate, apices more strongly so; disk flattened, glabrous, with punctate striae and with sulcus along lateral margins.

Ventrally: thoracic sternites with punctures moderate in size and dense laterally, very small and sparse medially; prosternal process feebly convex with sulcus along lateral margin; meso- and metasterna flattened, with weak midline concavity on metasternum; abdominal sternites convex; punctures small and sparse medially becoming large and dense laterally and on apical sternite; last visible sternite with apex truncately rounded, with deep sulcus around apical half producing deflexed margin; femora moderately robust; protibia with dense brush of setae on inner margin at apex; metatibia with similar brush along outer border.

Male genitalia, Fig. 13.

Length 19.0 mm; width 6.5 mm.

Redescribed from a male from MEXICO, Durango, 11.3 km N Durango, 13 August 1962, D. S. Verity [GHNC].

Female.—Differs from male as in *ambiens*.

Variation.—The general color varies from cupreous-green to blue-green. Most of the specimens from Jalisco have the red-orange margins of the elytra narrower than those from Durango, with 2 [DSVC, GCWC] having the red-orange elytral margins reduced to a few small irregular spots. In the series from Jalisco [DSVC] there are 2 with red-orange pronotal markings at the anterior angles. These color variations have not been observed in the series from Durango. The males vary from 15.0 to 19.0 mm long and from 5.2 to 6.7 mm wide; the females from 16.5 to 21.0 mm long and from 5.5 to 7.2 mm wide.

Type locality.—"Mexico, Kurango City" [sic, Durango], lectotype [BMNH]. The lectotype is one of 2 specimens in the BMNH. Since Waterhouse did not indicate how many specimens were before him at the time of its description, I designate as lectotype the specimen with the following labels: "Thrincopyge marginalis [sic] Waterh. (Type)"/"Kurango City Mexico Flohr." It is 21 mm long.

Geographical distribution.—MEXICO: Durango, Jalisco.

Hosts.—No biological information has been recorded for this species. It has been taken in Durango: 17.7 km E Revolcaderos, elev. 2377 m, 11 August 1972, MacNeill & Veirs, on palm grass [CISC, GHNC]; 8 km W

Durango, 17 June 1964, H. F. Howden [&GHNC]; 11.3 km N Durango, 13 August 1962; 31 km S Durango, 12 August 1962, D. S. Verity, all on *Dasylirion* sp. [&GHNC]; 29 km W Durango, 8 August 1973, D. S. Verity; 35 km W Durango, 8 July 1973, D. S. Verity, all on *Nolina* sp.; Jalisco, 6.5 km NW Tequila, 18 July 1966, D. S. Verity, G. C. Walters, on *Dasylirion* sp. [&GHNC]. **(New adult host records)**

Comparisons.—This species is discussed under *alacris* and *ambiens*.

Acknowledgments

Thanks are extended to W. F. Barr, Univ. of Ida., Moscow; D. S. Verity, Univ. of Calif., Los Angeles; R. L. Westcott, Ore. Dep. of Agr., Salem; and the publications committee of the Division of Plant Industry, Fla. Dep. of Agr. and Consumer Services, for their helpful suggestions concerning the manuscript; and the following for help in other aspects of this study and/or for the loan of specimens: W. F. Barr; W. W. Glosser, Audiovisual Dep., Kansas City College of Osteopathic Med.; C. M. F. von Hayek, BMNH; H. F. Howden, Carleton Univ., Ottawa, Ont.; W. A. Iselin, El Centro, Calif.; J. M. Kingsolver, USNM; E. G. Riley, Univ. of Mo., Columbia; T. W. Taylor, Ft. Davis, Tex.; Margaret Thayer, MCZ, Harvard Univ.; D. S. Verity; G. C. Walters, Los Angeles, Calif.; F. G. Werner, Univ. of Ariz., Tucson; and R. L. Westcott.

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Footnotes

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, p. 310

SCIENTIFIC NOTE

RECORDS OF CERAMBYCIDAE FROM COCOS ISLAND (COLEOPTERA)

A recent collection of Cerambycidae from Cocos Island was made available for study by R. Silberglied of Harvard University. Although the five species represented have all been previously recorded from the island by Linsley and Chemsak (1966, Proc. Calif. Acad. Sci., (4)33:237–247), we are making these records known.

The material, all taken at Chatham Bay, 8–11 April, 1979, R. Silberglied, includes the following species: *Parandra glabra* Degeer, 7♀, at light; *Taeniotes hayi* (Mutchler), 2♂♂, at light, 1♂, in flight (N. Smythe); *Acanthoderes circumflexus* Jacquelin duVal, 1♂, malaise trap; *Acanthoderes cocoensis* Linsley and Chemsak, 1♂, malaise trap; *Anisopodus longipes* Linsley and Chemsak, 5♂♂, 10♀♀, at light, 4♂♂, malaise trap.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 311–315

STUDIES ON NEOTROPICAL VELIIDAE (HEMIPTERA). V. NEW SPECIES OF *RHAGOVELIA*

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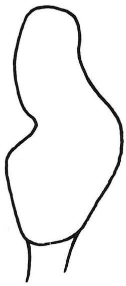
This paper is the fifth of a series intended to revise the veliid fauna of the New World. Earlier papers by Polhemus (1974, 1976, 1977) dealt mainly with *Microvelia* and *Paravelia*. A more recent paper by Smith and Polhemus (1978) treated all Veliidae of North America, but this fauna is depauperate compared to the Neotropical region and a similar work covering the latter would be a formidable undertaking. It is planned, therefore, that small segments of the fauna be treated as time permits. Reviews, keys and check lists will be published at appropriate times.

I am indebted to R. T. Schuh for the opportunity to study material from the American Museum of Natural History (AMNH). Unless otherwise noted, 60 units = 1 mm for all measurements.

Rhagovelia chiapensis, new species

Apterous male.—Dorsum brown black; abdominal tergites 6–8 shining medially; anterior eighth of pronotum except narrow median black area, much of venter lightly frosted; two (1 + 1) small quadrate spots on pronotum behind vertex of head brown. Venter blackish except sternite 8 medially, part of propleura, proepisternum, all coxal cavities yellow brown to brown; connexiva narrowly yellowish. Legs, antennae blue black; basal fourth of first antennal segment, anterior and posterior coxae, part of middle coxae, trochanters, base of anterior and posterior femora, first genital segment beneath yellowish to yellow brown. Pronotum of moderate length, covering mesonotum except for posterior angles; length: width, 66:86. Length of metanotum on midline, 8. Abdominal tergites 2–7 subequal in length (11–14), tergite 8 longer (26).

Proepisternum with 1–5 minute black conical setae adjacent to ventral angle of eye. Each abdominal sternite laterally with two (2 + 2) ovate slightly depressed hair-free areas having numerous tiny round glabrous pits. Dorsum thickly clothed with moderate length (8) fine brown semi-recumbent setae; dorsum of head, dorsum and sides of thorax set with much stouter longer (10–15) curved setae. Venter clothed with fine yellowish pubescence and scattered long yellowish hairs, not as shaggy as dorsum. Legs, antennae clothed with short to moderate length (2–6) yellowish to brown semi-recum-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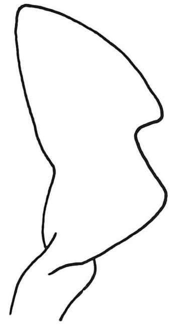
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Fig. 1. *Rhagovelia chiapensis* n. sp., left male paramere (setae not shown).
Fig. 2. *Rhagovelia aestiva* n. sp., left male paramere (setae not shown).

bent setae; femora, tibia, antennal segments 1–2 with numerous scattered longer (10–15) stout black setae. Posterior trochanters armed with 10–12 small brown pegs. Posterior femur armed at middle with a stout spine followed by ten smaller spines decreasing in length distally; basally with a row of 16 small black conical pegs extending from trochanter to median spine. Posterior tibia beneath with an evenly set row of short black distally directed conical pegs; short (2) apical spur present. Down-curving arolia of hind tarsi dorsoventrally flattened. Antennal formula I:II:III:IV; 68:36:37:35.

Proportions of legs as follows:

	femur	tibia	tarsal 1	tarsal 2	tarsal 3
Anterior	76	81	2	20	—
Middle	132	90	6	54	56
Posterior	108	110	3	13	24

Abdominal tergite 8 slightly excavate beneath, forming a shallow transverse sulcus; posterior margin with a row of short (2) evenly spaced posteriorly directed setae. Parameres symmetrical, shape as shown in Figure 1. Length 3.88 mm, width 1.48 mm (paratype).

Apterous female.—Dorsum black to grey black; abdominal tergites not shining. Connexiva broadly yellow on basal two visible segments, narrowly yellow on remainder. Dorsum with moderate length brown setae only on postero-lateral pronotal dorsum and first connexival segment; ventrally with short recumbent yellow pubescence. Otherwise coloration and hairiness as in male.

Proepisternum with about 10 minute black conical setae behind ventral angle of eye. Middle femur flattened over most of its length. Posterior femur armed just beyond middle with a moderate length (12) spine, followed by a row of five smaller spines decreasing in length distally. Posterior tibia basally with a row of 7–8 tiny black pegs.

Abdomen distally upturned at a 45° angle to remainder of body; connexiva abruptly incurved and reflexed at a 45° angle after first visible segment (3), narrowly separated over tergite 5; divergent caudad, vertical distally, terminating in an acute angle slightly beyond tergite 8. Dorsum of tergite 9 strongly bent downward distally; tergite 10 directed downward at a 90° angle to distal part of abdomen.

Length 3.38 mm, width 1.83 mm (paratype; length measured with head, thorax and base of abdomen horizontal).

Macropterous female.—Coloration and most other characteristics as in apterous females. Dorsal setae on pronotum much shorter. Pronotum prolonged into long straight simple lobe-like process extending posteriorly barely above wings; process increasingly shaggy distally, with moderate length (8) curved setae distally; humeri moderately produced. Abdomen straight, not upturned. Wings black basally, brown-black distally, extending well beyond apex of abdomen. Abdominal tergite 9 mostly horizontal, slightly downturned caudad; tergite 10 bent downward at about 75° angle to longitudinal axis of body. Connexiva broadly yellow, yellow stripe narrowest basally.

Length 4.83 mm (to tip of wing), width 2.13 mm.

Material.—Holotype, apterous male, allotype, apterous female, Mexico, 16 mi SE San Cristobal de las Casas, CL1330, I-14-1970, J. T. Polhemus (in Polhemus collection). Paratypes as follows: 51 apterous ♂♂, 39 apterous ♀♀, 29 nymphs, same data as holotype; 58 apterous ♂♂, 50 apterous ♀♀, 1 macropterous ♀, 26 nymphs, Mexico, SE of San Cristobal de las Casas, CL1079, V-2-1964, J. T. and M. S. Polhemus. Paratypes in the Polhemus collection, AMNH, USNM and other museums.

Comparative notes.—*Rhagovelia chiapensis* n. sp. belongs to the *Rhagovelia obesa* Uhler group established by Bacon (1956). It drops out at the second part of couplet 3; if forced beyond, it keys to *R. obesa* but clearly is not. While most closely related to the latter and *Rhagovelia knighti* Drake and Harris, the female differs from both in having the connexiva widespread terminally and diverging posteriorly, the abdomen upturned distally at a 45° angle, and the terminalia turned downward at a 90° angle to the distal part of the abdomen. The male of *chiapensis* differs from these two species in the hairy dorsum and dorsal median shining areas only on the posterior two or three abdominal tergites; both sexes of *chiapensis* are relatively much broader than other members of the *obesa* group. This species is so far known only from one small forest stream in the pine highlands of southern Chiapas.

Rhagovelia aestiva, new species

Apterous female.—Dorsum brown black; abdominal tergites 8–9 shining medially; anterior two-thirds of pronotum, pleura, much of venter lightly frosted; anterior third of pronotum with elongate orange brown spot behind vertex. Venter blackish except sternite 8 broadly fuscous; connexiva concolorous with venter, margins of segments 4–8 shining. Legs, antennae fuscous to blue black; basal fourth of first antennal segment, bucculae, base of rostrum, coxal cavities ventrally, anterior and posterior coxae and trochanters yellow to yellow brown. Pronotum short (25), clearly shorter than exposed mesonotum (38); width of pronotum 64. Abdominal tergite 2 short (10), tergites 3–6 subequal in length (13–15), tergites 7–8 longer (20, 27 respectively).

Proepisternum, jugum of head without noticeable black setae. Abdominal sternites laterally with sparse pubescence, hair-free areas with tiny round glabrous pits barely noticeable. Dorsum of head, thorax, abdominal stergites 8–9, basal half of tergite 7, abdominal venter except laterally thickly clothed with brown recumbent pubescence, more yellowish on venter medially; longer pubescence on sides of abdomen, dorsum of head, posterior part of mesonotum. Abdominal tergites 2–6 hair-free. Legs, first two antennal segments, head, thorax at sides with numerous scattered longer (8–15) stout black setae. Trochanters unarmed. Connexiva reflexed, almost meeting over tergite 6, slightly divergent posteriorly.

Intermediate femur slightly flattened over most of its length. Posterior femur flattened beneath, armed at distal ⅝ with a short (4) spine followed by three smaller spines decreasing in length distally; unarmed basally. Posterior tibia unarmed, with a short straight spur distally. Downcurving arolia of hind tarsi dorsoventrally flattened, long, acuminate; upcurving arolia leaf-like, slender, flattened surface vertically oriented. Antennal formula I:II:III:IV;55:27:33:32.

Proportions of legs as follows:

	femur	tibia	tarsal 1	tarsal 2	tarsal 3
Anterior	67	68	2	16	—
Middle	114	86	5	46	47
Posterior	80	108	3	8	22

Length, 3.75 mm; width, 1.25 mm.

Macropterous male.—Coloration and hairy vestiture similar to apterous female except as follows: connexival margins not shining; posterior margin of pronotum roundly produced, set with long recumbent setae. Abdominal tergites 6–7 shining medially; length of tergites 2–6 subequal (10–13), tergite 7 longer (22). Wings broken off near base.

Posterior femur armed at middle with a medium length (8) curved spine, followed by 7 smaller spines decreasing in length distally. Posterior tibia with an evenly set row of short black distally directed conical pegs; short straight apical spur present. Antennal segment 3 flattened, broad (11).

Seventh abdominal sternite not depressed but shining medially. Genital segments brown, without ornamentation; parameres symmetrical, shape as in Figure 2.

Length, 3.70 mm; width, 1.5 mm.

Macropterous female.—Similar in most respects to preceding. Hemelytra with long hairs on basal half; extending beyond apex of abdomen.

Length (to end of hemelytra), 4.00 mm; width, 1.55 mm.

Material.—Holotype, macropterous male, and allotype, apterous female, Haiti, NE Foothills, La Hotte, 2400 ft, Oct. 10–24, 1934, Darlington, in AMNH. Paratypes, same data, 1 ♂ macropterous; 5 ♀♀ apterous; 3 ♀♀ macropterous (wings broken off near base on all but one female), 1 nymph; in AMNH and J. T. Polhemus collection.

Comparative notes.—*Rhagovelia aestiva* clearly belongs to the *abrupta* group as characterized by Bacon (1956) and Matsuda (1956), and is the third known *Rhagovelia* species wherein the males have the third antennal segment flattened and dilate, *Rhagovelia secluda* Drake and Maldonado and *Rhagovelia agra* Drake being the others. In Bacon's (1956) work, *aestiva* keys to the *torquata-vivata* complex but differs from these in the less heavily armed posterior femora of both sexes, darker coloration, and inflated third antennal segment of the male. *R. aestiva* differs from *secluda* and *agra* in having the pronotum clearly shorter than the exposed portion of the metanotum (vs. longer in *secluda* and *agra*).

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Footnote

[1] Contribution from the University of Colorado Museum, Boulder, 80309 and the Martin Marietta Corporation, P.O. Box 179, Denver, Colorado 80201.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 316–318

FIELD OBSERVATIONS ON THE BIOLOGY OF *TETRAGNATHA EXTENSA* EMERTON, IN A RIPARIAN HABITAT (ARANEAE: TETRAGNATHIDAE)

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The following field observations on the biology of *Tetragnatha extensa* Emerton were made at the Nature Conservancy's McCloud River Preserve in Siskiyou County, California, from August 1–15, 1976 as part of a larger team study examining the effects of changing water levels on stream arthropods. This study site is described by Resh and Sorg (1978) and Tippets and Moyle (1978).

Gerhardt (1923) observed in the laboratory a European *T. extensa* female mating with a second male a day after the first mating. In contrast, LeSar's (1978) laboratory mating studies with *T. laboriosa* Hentz indicated that females mate only once. The following describes male × female, male × male, and female × female interactions involving *T. extensa*.

On August 5, 1976, between 21:45 and 22:00 hr, I observed a female *T. extensa* mate with two males consecutively. The second male was present on the web perimeter when the first male was observed in copula. At one point the second male approached the mating pair but was repelled by vigorous leg movements from the mating pair. The leg movements began as the second male approached and they ceased as the male retreated to the web perimeter. Immediately after the first male completed copulation and left the web the second male approached the female and mating proceeded. During this second mating another adult female from a nearby rock entered the web and successfully removed and exited with a chironomid midge in her chelicerae. Copulation lasted about three minutes in the first mating and 10 minutes in the second. In another example, on August 11, at 2100 hr, a male, after mating for approximately seven minutes, was chased to the perimeter of the web by his mate. However, the pursuit by the female was not vigorous; the male managed to stop and remove two chironomids from the web before reaching the perimeter. The female ceased approaching her mate and returned to the center of her web just before he left the web.

On August 9, at 22:22 hr, I saw two males on a web approach each other and make contact with their chelicerae and first pair of legs. During the seven seconds that they were in contact the first pairs of legs were held at right angles to the body axis while the chelicerae of both spiders were

Table 1. Orders and families of insects removed from *Tetragnatha extensa* webs.

Ephemeroptera	Lepidoptera
Baetidae	Geometridae
Heptogeniidae	Trichoptera
Diptera	Rhyacophilidae
Sciomyzidae	Hymenoptera
Cecidomyidae	Formicidae
Dixidae	Coleoptera
Tipulidae	Staphylinidae
Psychodidae	Homoptera
Simuliidae	Aphidae

interlocked. This position strongly resembled the male × male encounter position of *Linyphia triangularis* (Clerck) described in detail by Rovner (1968). The spiders separated uninjured with one spider remaining on the web and the other retreating to a nearby rock. Other male × male encounters were similar but were too brief for detailed observation.

On August 9, at 1500 hr I observed three adult females, walking on a tree branch overhanging a creek, make simultaneous contact with each other. After sparring briefly with their first pair of legs all three spiders dispersed to separate branches approximately one half meter apart. Rovner (1968) observed female × female encounters in *L. triangularis* but they were on the webs of one of the combatants.

Although it is well known that tetragnathids commonly prey on nematocerous flies (Kaston, 1948; Bristowe, 1941; Gertsch, 1979), I could find few potential or actual prey items of tetragnathids in natural habitats reported in the literature. LeSar (1978) lists prey items of *T. laboriosa* in soybean fields. Small insects, especially nematocerous flies, make up the bulk of potential prey items found in *T. extensa* webs (Table 1). I saw *T. extensa* feeding on mayflies and chironomids, and these items were carried from the web to an adjacent sheltered rock surface before feeding. Feeding in sheltered areas may be an adaptation to the splashing water. In contrast, LeSar (1978) observed *T. laboriosa* feeding in the hub and elsewhere in the web. Prey was not always removed immediately by *T. extensa*. I counted forty-one chironomids in one web on August 11 at 21:15 hr. The adult female occupant of this web often entered the web, removed a chironomid, and retreated to a rock to feed. Males were seen to enter the webs of females and remove prey, while the females were in their retreats. At 21:30 hr I saw an adult female *T. extensa* eating part of her web and the minute prey items it contained, while selectively cutting out debris such as wind blown seeds. The prey were eaten as the web was being consumed, and thus added to the web nutrients. As Breed et al. (1964) suggested, this behavior could be energetically efficient since the silk is redigestible. The small prey probably were not energetically worth individual predatory responses (see Peakall and Witt, 1976 for a discussion of energy budgets in an orb weaving spider).

I detected no apparent vertical stratifications of *T. extensa* webs according to spider size. The webs of both adults and immatures were generally found within a range of 1.5 meters above the water. I did find vertically oriented webs arranged one behind the next under overhanging rocks, but not enough micro-habitats of this type were found to allow me to draw any conclusions on horizontal stratification based on spider size.

To measure dispersal potential for adults, ten *T. extensa* were captured, marked with fluorescent dye, and released on one bush adjacent to the river. Four days later four marked spiders were recaptured in webs ranging from 3 to 33 meters downstream. The ability to reestablish webs and to run across water probably aids tetragnathids to survive in environments with fluctuating water levels.

Acknowledgments

I thank I. A. Boussy, B. J. Kaston, W. J. Gertsch, C. E. Griswold, E. I. Schlinger and especially J. S. Rovner for their comments and suggestions on this manuscript. R. Dileo identified the insects.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 319–322

SCIENTIFIC NOTE

EVIDENCE FOR A RETURN MIGRATION OF *VANESSA CARDUI* IN NORTHERN CALIFORNIA (LEPIDOPTERA: NYMPHALIDAE)

Although the existence of a migration has never been proven by mark-recapture studies, it is generally accepted that the Painted Lady, *Vanessa cardui* (Linnaeus), migrates northward in late winter and early spring on the Pacific coast of North America, proceeding in a series of steps corresponding to successive generations (Tilden, 1962, J. Res. Lepid., 1: 43–50). The existence of a southward return migration is less widely accepted, either here or in the Palaearctic region. There are at least two reasons for this: few observers are afield in September to November to see it, and it never seems to attain the great density characteristic of northward flights in favorable years. The latter point is crucial, because "thin" migrations are often not recognized as migrations at all. This has led some observers to believe that even the northbound flights occur only in high-density years, and leads them to infer causation from this alleged correlation. Animals present in the north in low-density years are then interpreted as a "resident" population upon which the mass movements are intermittently superimposed. The timing, directionality, and sexual condition of *V. cardui* through the season argue against this interpretation and instead suggest that long-range dispersal is a characteristic seasonal phenomenon in this species and is independent of density. The 1979 season provided especially interesting data bearing on this idea.

At the latitude of Davis and Sacramento the first *V. cardui* of the season may occur as early as 7 February (as in 1976) to as late as 20 April (as in 1975). In 1979 several were seen (two taken) on 18 March at Davis; all of these were flying due north. No other adults were seen until 7 April. At least one gravid female must have arrived in late February, since one half-grown larva was found (on *Lupinus succulentus,* an unusual host) at Gates Canyon, Solano County, on 8 March. The 18 March animals were too fresh to have flown all the way from the desert. The two captured specimens were both males; therefore, it is not known if this group included gravid females. On 7 April large numbers of frayed *cardui* appeared on a broad front across Yolo County, moving northward. All females examined were gravid, and egg-laying was seen from the first. Numbers fluctuated through early May, with occasional surges but with some butterflies always present. Larvae were numerous through this period. The resulting butterflies must have departed almost immediately after hatching, since none of the local collectors noted abnormally high numbers of fresh *cardui* in June, although by early July there were thousands of abandoned larval nests on various weeds.

Virtually no adults were present in July and August, and no larvae at all were seen in the Sacramento Valley after July 1.

On 29 August a southward-moving front of *cardui* passed through Davis. Its arrival was as dramatic and well-defined as the northward one almost five months earlier. Ovipositing on mallows was observed the same day. Thereafter, *cardui* were continuously present into November. The numbers varied from day to day, with eight distinct surges. When not at flowers the butterflies moved in classic migratory fashion, flying due south to SSW, often against the wind, and going over, rather than around, obstacles. Individual *cardui* were observed in one place visiting flowers in gardens for two or three days and then not seen again. Thirty-two individuals were marked with a blue marking pen in the Experimental College gardens at Davis in October; only four were seen again, all within 3 days of marking.

At Donner Pass (Nevada-Placer Counties, 2100 m), a few *cardui* were flying on 12 July but none seen on 30 July. In the mass-migratory year 1973 larvae were very numerous at Donner, but in 1979 no larvae were found, despite careful searching. However, on 10 September several dozen adults were found nectaring at Rabbitbrush (*Chrysothamnus*) flowers. By 30 September the amount of blooming Rabbitbrush had declined greatly, but adult *cardui* were still common. Two ovipositing females were also seen in the western foothills between Auburn and Nevada City on the latter date. At 1400 m on the South Yuba River they were common at *Aster* blossoms on 3 October; a few were seen there on 15 October, but none at Donner on the latter date.

On 20 September *cardui* was the commonest butterfly at Deadfall Lakes, Trinity-Siskiyou Counties, about 50 having been seen on a handful of Rabbitbrush plants at 2100 m. The next day another 50 or so were seen visiting the same species of plant in Scott Valley, especially at French Creek and the banks of the Scott River at Callahan. Many potential hosts were searched in vain for old larval nests and damage. There was no evidence of large-scale breeding locally, nor were many larvae seen anywhere in the Trinity-Eddy area, despite four collecting trips to this region in the 1979 season. Yet *cardui* were generally distributed in late September up to the Klamath River at Humbug, Siskiyou County!

How exceptional are the events of 1979? Tilden (*loc. cit.*) speaks of "large populations . . . late in the fall at high elevations," and gives examples. These autumn concentrations on flowers, especially composites, are quite common and apparently bear no relation to the abundance of larvae in the same area earlier in the season. Both sexes are present; if the sex-ratio deviates markedly from 1:1, it is toward larger numbers of females. Early in the fall, and especially at high elevations, females contain a great deal of yellow fat and no well-developed ova. Later, and at lower elevations, the proportion of gravid females increases to near 100% at the end of the flight.

Autumn *cardui* are very large and richly colored, with forewing lengths of 32–35+ mm. They are phenotypically very similar to the brood produced under "optimal" conditions in spring at Sacramento from eggs laid by March immigrant females. They are easily told from the northbound migrants which originate in winter in the desert and from the occasional early winter emergent in the Sacramento Valley, which resembles the northbound migrants.

On 6 October 1979 about 3 dozen *cardui* were found, apparently feeding on honeydew on the south side of a California Walnut (*Juglans hindsii*), in disturbed riparian habitat at Rancho Cordova, Sacramento County. Butterflies were observed from ground level to 15 m. The weather at 1300–1330 h was as follows: breaks in altostratus overcast, 27°C, R.H. ca 40%, wind calm. There were no *cardui* on nearby *Baccharis pilularis* ssp. *sanguinea* in bloom, and only a handful were scattered over nearby grass- and woodland. All of the *cardui* were large. Four females were found to be barren and full of fat. On 26 October the tree was still covered with honeydew and *cardui* were again abundant, but uniformly distributed over the habitat, with only two seen at this tree.

On 7 October large *cardui* were common on composites (*Aster, Grindelia, Pluchea, Baccharis, Centaurea*) at the Suisun Marsh, Solano County. Four females were collected: two were very worn and had many ova; two were less worn and had only fat. In addition, a locally-reared, teneral *cardui* of the winter (desert) phenotype was found; its forewing length was 25 mm, *vs.* 32+ mm for the others. On 10 October very worn females were common at Gates Canyon and at Vacaville, Solano County, flying in a uniformly southerly direction in early afternoon. Three ovipositions were seen on *Malva* and one on *Althea*.

The last two surges of *cardui* in the Valley were on 17 and 27 October. On the latter date they were more abundant than at any time previously at both Davis and Suisun City, and on 28 October similarly were more common at Gates Canyon and Vacaville than previously. A sample of 24 females collected on these two days (17th and 27th) was uniformly gravid. Larvae were common on *Malva* throughout the area into early November. Every female brought into the lab in late October oviposited freely.

The most parsimonious explanation of these observations is that there is a return southward migration of *V. cardui* in autumn, and that it is, in effect, a "mirror-image" of the northward one in spring. The biggest problem is where the butterflies are coming from. Although the most likely source is the Pacific Northwest, we cannot rule out the possibility that the autumn migrants were hatched at low elevations in spring and underwent altitudinal or latitudinal displacement, followed by aestivation. Aestivation has not been reported in *V. cardui,* but is known in other nymphalids, viz. *Nymphalis antiopa* L. in northern California, and in females of *Speyeria zerene* (Bdv.) and *S. coronis* (Behr) (S.R. Sims, *pers. comm.*), and in the satyrid *Coenonympha california* Westwood.

The reproduction by *cardui* in autumn 1979 failed. By mid-January only two larvae could be found in fields where thousands of eggs had been laid. These were allowed to pupate on a sheltered outdoor balcony; one died and the other, which had pupated 21 January, eclosed on 17 February 1980 as a perfect specimen during a violent rainstorm. No *cardui* were seen at all through early March at Davis, though they were common at Santa Barbara on February 11–12. Winter 1979/80 was mild and very wet at Davis. By mid-June 1980 only one *cardui* had been seen in Davis, and no larvae had been encountered.

California's summer drought poses a problem for insects which can be solved only by diapause/aestivation on one hand, or migration on the other (Shapiro, 1975, J. Res. Lepid., 14:93–97); there is no way to breed continuously in the absence of hosts. In at least part of the state, overwinter survival may also be a major problem. The functional parallelism of diapause and migration (Dingle, 1978, *Evolution of Insect Migration and Diapause,* Springer-Verlag, New York), viewed in this context, frees migration from causal dependency on population density and allows us to consider the possibility that it is a normal seasonal aspect of the biology of the animal.

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PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 323–331

OBSERVATIONS ON THE BIOLOGY AND DISTRIBUTION OF *SIMULIUM TESCORUM* (DIPTERA: SIMULIIDAE) IN CALIFORNIA AND ADJACENT AREAS[1]

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The larval habitat of the family Simuliidae is generally typified as cold, fast running streams. *Simulium tescorum* Stone and Boreham, is an exception, since its larvae are found in small warm streams in the lower desert regions of California and western Arizona. The water temperature in these streams sometimes exceeds 30°C and the stream velocity may be as low as 2 cm/sec.

Simulium tescorum is also one of the most serious black fly pests in California. Although its pestiferous nature has minimal impact on man because of its small and often isolated desert habitats (Mulla and Lacey, 1976a), it occasionally needs to be controlled (Pelsue et al., 1970).

Very little is known about this unusual species, other than a few brief biological notes and a thorough description of the species (Stone and Boreham, 1965) and studies on its larval feeding rates (Mulla and Lacey, 1976b). This paper presents information on the number of larval instars, contains a description of the egg stage, extends the known distribution, and provides some biological notes for the species.

Methods and Materials

Eggs and larvae of *S. tescorum* were collected from Thousand Palms Canyon in the lower Colorado desert of southern California. This area consists of a series of natural oases along Mill Creek in the region of the San Andreas fault, north of Thousand Palms, Riverside County, California. Eggs were collected and transported to the laboratory at the University of California, Riverside, where each batch was divided into two nearly equal lots. One half of each lot was fixed in aqueous Bouin's solution for 12 hours, removed and then stored in 70% ethanol. The other half of each lot was placed in a rearing unit using the rearing procedures as described by Lacey and Mulla (1977a) and maintained at 19°C. After hatching, the larvae were allowed to mature and these, with pupae, were then preserved in 80% alcohol. Several eggs from each of five individually preserved batches were measured, and the number of eggs per batch was counted.

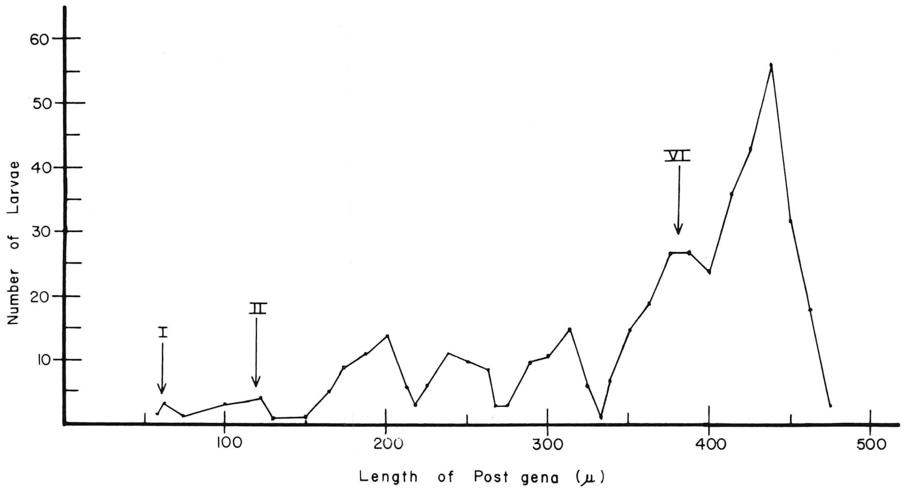

Fig. 1. Frequency distributions of the lengths of the postgenae of larvae of *Simulium tescorum* from two collections, April 15 and 22, 1977, at Thousand Palms Canyon, California (n = 453).

Larvae collected in the field were preserved in 80% ethanol. For the purpose of determining the number of larval instars, the length of the postgena and of the whole larva were measured with an ocular micrometer in a Zeiss® dissecting microscrope as described by Fredeen (1976). Lengths of the postgenae were then grouped following the procedures of Sokal and Rohlf (1969) and plotted against the number of larvae in each group. In all, 453 larvae were measured.

Periodic observations on larval biology were made primarily in the Thousand Palms Canyon from December 1973 until January 1978. Stream velocities were determined with a float and stopwatch; water temperatures were measured with a mercury thermometer and the pH was determined in the laboratory with a pH meter. Additional observations on the larvae of this black fly were made at Willis Palms, an oasis just south of Thousand Palms Canyon, and at Coyote Creek north of Borrego Springs, San Diego County, California.

New distribution records for *S. tescorum* were established by collecting throughout southern California, southern Nevada and northwestern Arizona between December 1973 and November 1977. Other unpublished records were obtained from specimens in the Los Angeles County Museum and the entomological museum and medical entomology collections of the University of California, Riverside. These records supplement those of Stone and Boreham (1965) and Hall (1972).

Results and Discussion

Eggs

The eggs of *S. tescorum* occur in small to medium batches with 96–275 eggs per batch ($\bar{x}$ = 171, n = 5). They are deposited at the water line usually on sedges and cattails trailing in the water current. The largest egg batch found might have been two contiguous batches. The bluntly triangular eggs measured 94.4 ± 2.91 μ by 55.6 ± 1.55 μ (n = 32) and were oriented on their large ends in a position similar to that of eggs of *S. aureum* Fries described by De Foliart (1951) as reported by Peterson (1959), or in a leaning position. They were readily separated from the eggs of *S. argus* Williston and *S. vittatum* Zetterstedt, which are oriented on their sides and often deposited in a meandering line and frequently in large masses (Lacey and Mulla, 1977b).

Newly laid eggs were creamy white in color and gradually darkened to deep brown on maturing. Prior to hatching, the embryo could be seen clearly through the chorion.

Larvae

The frequency distributions of the lengths of the postgenae of the larvae (Fig. 1) indicate that there are seven larval instars. Although very few first instars were found, they could be readily separated from the second instars by their small size and the presence of the egg burster. Penultimate and ultimate instars were separated on the basis of size and the degree of development of the histoblast, and the complete lateral separation of the cervical sclerites. The peaks representing each of the other four instars were easily distinguished.

The mean lengths ± s.d. for the postgenae of each instar are graphed in Fig. 2. The means of each instar fall on, or close to, the regression line drawn through the intercept (−0.857 μ) and the average of each variable (instar IV, 245.29 μ). Utilizing the least squares method, the natural log of the postgenal length plotted against the instar number generates the regression line $\log_e Y = .3036x + 4.1211$.

The ratio of head capsule growth in successive instars going from the first to the seventh, was 1.75, 1.66, 1.30, 1.24, 1.21, 1.17 respectively. These findings differ somewhat from those of Fredeen (1976) for *S. arcticum* Malloch for the first and second instars. This may be due in part to the low numbers of *S. tescorum* larvae that were measured for each of these two instars.

The body lengths ± s.d. of the seven instars of *S. tescorum* are: 0.46 ± 0.05, 0.90 ± 0.11, 1.76 ± 0.22, 2.29 ± 0.26, 2.95 ± 0.34, 4.06 ± 0.56, and 5.15 ± 0.39 mm respectively. The larval growth ratios were 1.96, 1.96, 1.30,

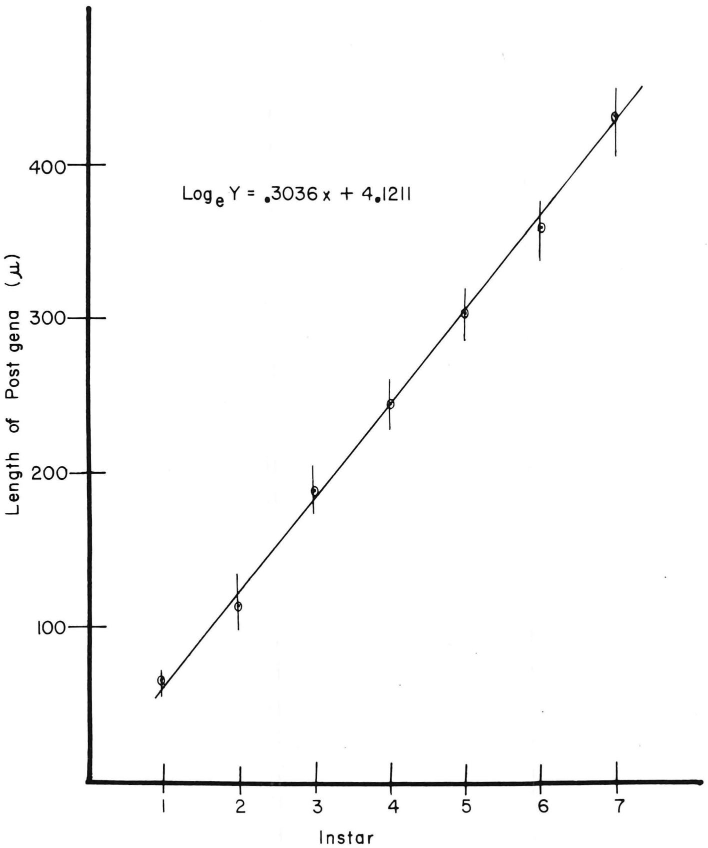

Fig. 2. Mean lengths ± s.d. of the postgenae of the seven larval instars of *S. tescorum*.

1.29, 1.38, and 1.26 for the first through the seventh instars respectively. Here again the first two instars were considerably different from the other five. The ratio of growth for the third through seventh instars was fairly constant, indicating a geometric progression of growth (Dyar's rule, from Wigglesworth, 1972).

Ultimate instars of *S. tescorum* reared in the lab from field-collected eggs had an average postgenal length of 406 ± 8.9 μ and a body length of 4.73 ± 0.19 mm (n = 21). These measurements are considerably lower than the larval and postgenal lengths of the seventh instars that were collected in the field. The 95% confidence limits (t-distribution) for the means of the postgenae of lab-reared and field-collected ultimate instars are 401.95–410.05 μ and 428.45–433.55 μ respectively. It is thus possible that measurements of anatomical characters of larvae collected from various habitats that differ considerably from each other will show significant variation. The larvae of *S. tescorum* that were collected at Thousand Palms Canyon were found in a variety of stream types, some having wide temperature differences. Possibly for this reason, a wider variation in the measurement of the postgenae of each instar was observed in our studies than that reported by Fredeen (1976) for *S. arcticum*.

Larval Habitats

The larvae of *S. tescorum* were found attached to rocks, roots and trailing vegetation in diverse lotic habitats in the lower desert. A seep in Willis Palms with flowing water ca. 2 cm wide and less than 1 cm deep supported low numbers ($<1/cm^2$) of larvae in current as low as 2–3 cm/sec. No other species were found at this location. Several small natural and artificial streams in Thousand Palms Canyon having currents varying from 0.3 to 0.6+ m/sec, pH's from 7.4 to 8.9 and temperatures ranging from 10–32°C supported different densities of *S. tescorum* larvae. The greatest densities ($11/cm^2$) were observed in an area having a temperature of 22°C, a pH 8.6, and a water velocity of ca. 0.6 m/sec just below a spillway draining a pond. In water at 10–22°C, *S. tescorum* was found in association with *S. argus, S. aureum* and *S. vittatum* and occasionally *S. virgatum* Coquillett and rarely *S. piperi* Dyar and Shannon. They were still found with *S. argus* and *S. aureum* at higher temperatures but only *S. tescorum* were found at 32°C. In a medium size stream (Coyote Creek, San Diego County) they were found with *S. argus, S. virgatum,* and *S. vittatum.* Stone and Boreham (1965) reported *S. tescorum* in association with *S. argus, S. aureum* and *S. encisoi* Vargas and Dias in a current velocity of 0.3–0.9 m/sec at 16.7°C.

In the lower Colorado desert (Thousand Palms Canyon), larval populations begin to decline in late April and almost disappear during the summer. The larvae that were collected in mid and late April 1977 showed a paucity of early instars (Fig. 1), indicating a decline in oviposition at this time of year. The reappearance of larvae from the hatch of newly laid eggs in October is followed by a steady increase in numbers.

Occasional flash floods eliminated larval populations especially in the late fall of 1977 and the early winter of 1978, which was an unusually wet season for the lower desert.

Adult Activity

Host seeking activity of *S. tescorum* females in Thousand Palms Canyon is evident from late October until late May or early June depending on the severity of the late spring temperatures. Females are initially attracted to the head region of humans, but appear to prefer the arms and hands for bloodfeeding. Once biting has commenced the females are determined feeders and take from 3–8 minutes to engorge.

Although biting may occur throughout the day, two daily peaks of activity are apparent during the spring, one in the morning and one at dusk. From late April until late May the morning feeding activity drastically subsides after 0930–1000 hr. Also, the intensity of biting activity begins to decline from late April until the beginning of summer. Extremely high summer temperatures and low humidity are undoubtedly responsible for the seasonal decrease in the population. Occasionally the air temperatures from June through September may reach as high as 50°C and temperatures around 43° are not uncommon.

While their activity in the lower desert during the summer is negligible to nonexistent, adults of *S. tescorum* have been collected from early June through July 30th in Whitewater Canyon northwest of Palm Springs, California. The presence of this species in the higher cooler canyons which border the lower desert may be an indication of their oversummering, and from these canyons the species then migrate into the desert during the cooler months.

Information from specimens of *S. tescorum* collected in other low desert habitats such as Death Valley (Scotty's Castle, and Furnace Creek) indicates that their activity in these localities parallels that of the lower Colorado desert populations. There are, however, records of specimens collected in Death Valley in the months of June and September. Periodic searches in parts of northwestern Arizona throughout the summer of 1974 for adults and larvae of *S. tescorum* were unsuccessful.

Male Swarming

The swarming activity of the males of *S. tescorum* was only observed occasionally in the course of these studies. The densest, most active swarm was observed on March 17, 1975, at Thousand Palms Canyon at 1400 hr during the approach of a storm. The swarm began as a loose aggregation of males several meters wide, oriented toward the leeward side of a narrow line of salt cedars, *Tamarix pentandra* Pell, that lined a small stream on the west end of the canyon. The initial height of the swarm was 1–3 m above the ground. As the storm front approached, the males condensed into tighter, more active groups. The flight activity and mating as well as female biting activity intensified until it peaked just before precipitation.

Similar spontaneous bursts of activity have been reported for other black flies by several authors, such as Wellington (1974), who attributed the "almost frenzied activity" associated with a traveling frontal system to the minute and rapid fluctuations in the barometric pressure. Normally, as men-

Fig. 3. Known distribution of *S. tescorum* in California, Arizona and Nevada. Roman numerals following each locality indicate the months in which collections were made.

tioned above, midafternoon adult activity in the Thousand Palms oasis was minimal in the spring. The lowered temperature and light, and increased humidity, as well as the fluctuations in barometric pressure, were possibly responsible for the observed intense activity.

Distribution

The known distribution of *S. tescorum* is shown in Figure 3. Six new records extend the southern range to Coyote Creek (near Borrego Springs, San Diego County, California). Throughout this range, larvae were not found above 458 m (a location near Gavilan Hills, Riverside County, California). Most of the larval collections were made in the lower desert of southeastern California from below sea level (lower Colorado desert) to 177 m (Coyote Creek, Anza Borrego Desert). Adults, however, were taken at higher altitudes. In Arizona, biting females were collected by Wayne L. Kramer at an elevation of 923 m in late March 1975 near the Havasupai Indian Reservation adjacent to the Grand Canyon.

It was interesting to note that in spite of the availability of larval breeding habitats in the Mohave Desert near Victorville, California (elev. 835 m), neither larvae nor adults of *S. tescorum* were encountered during our 2 or more year study. Similarly, the area near Las Vegas, Nevada (elev. 625 m), where other *Simulium* species breed, was negative for this species. Since adults (at some locations) are found at higher elevations during the warm weather, the distribution of *S. tescorum* is probably limited by the winter water temperatures of streams at the higher elevations or the more northerly regions.

By collecting near small streams one may expect to extend the range of this low-desert species in California, Arizona, Nevada and possibly northern Mexico. Additional collecting at various locations should provide a more accurate picture of the seasonal occurrence of this locally important black fly species.

Acknowledgments

We are grateful for the technical and clerical assistance of Joann and Jacuilin Lacey. The collecting assistance rendered by Mr. Richard Hicks, Clark County Health Dept., Las Vegas, Nevada is duly acknowledged. We also thank Saul Frommer for providing (unpublished) distribution records for *S. tescorum,* and Rick Wilhelm, Dart Enterprises, for permitting us to work in the Thousand Palms Canyon Reserve.

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Footnotes

[1] Send reprint requests to Mir S. Mulla.

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BOOK REVIEW

Vocabularium Nominum Animalium Europae Septem Linguis Redactum (Septemlingual Dictionary of the Names of European Animals). Edited by Laszlo Gozmany. Vol. I, 1171 pp.; Vol. II, 1015 pp. (7 × 10½″). Budapest, 1979. Hardbound, $200.00 (published by the Akademia Kiado, Budapest, Hungary).

This well organized dictionary contains 12,026 original entries (species, etc.), and an estimated 80,000 names in seven languages (Latin, German, English, French, Hungarian, Spanish, and Russian). It also includes all economically important species of Europe from the mid-Atlantic (Long. 30°W) to the Ural Mountains, Caspian Sea, Caucasus, Black Sea and territories north from (and including) the Mediterranean Sea. Names adopted in the dictionary are those used in European zoological literature in the 20th Century.

The dictionary is unusually well organized, concise and easy to use. There are only 8 kinds of symbols (incl. ♂, ♀, ☿) and 36 abbreviations, all of which are familiar to the users of any dictionary.

All entries are chronologically numbered and arranged in alphabetical order. The scientific names are coded, with reference to a systematic list of the animal kingdom (pp. 1129–1171), which helps the reader to identify the systematic position of the species to the family level.

Vol. II is the index to common names presented in six languages. Each entry (over 60,000 of them) ends with a set of numbers referring to the numbered scientific names in Vol. I. For the Russian names cyrillic letters are used.

This monumental work is the result of many years of hard work by dedicated specialists. Certainly, it is a very useful addition to any library interested in economic zoology, and in particular in entomology.

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ZOOLOGICAL NOMENCLATURE

A.N.(S.) 113 16 May 1980

The Commission hereby gives six months' notice of the possible use of its plenary powers in the following cases, published in *Bull. Zool. Nom.* Volume 37, part 1, on 8 May 1980, and would welcome comments and advice on them from interested zoologists. Correspondence should be addressed to the Secretary at the above address, if possible within six months of the date of publication of this notice.

2197 *Peggichisme* Kirkaldy, 1904 (Hemiptera, Heteroptera); proposed designation of a type species.
2216 LYMANTRIIDAE Hampson, [1893] (Insecta, Lepidoptera); proposed precedence over ORGYIIDAE Wallengren, 1861 and DASYCHIRIDAE Packard, 1864.
2264 *Harminius* Fairmaire, 1852 (Insecta, Coleoptera); proposed designation of a type species.
2291 *Chrysolina* Motschulsky, 1860 (Insecta, Coleoptera); proposed conservation.

A.N.(S.) 114 30 June 1980

The Commission hereby gives six months' notice of the possible use of its plenary powers in the following cases, published in *Bull. Zool. Nom.* Volume 37, part 2, on 19 June 1980.

1175 *Heterelis* Costa, 1887 (Insecta, Hymenoptera): proposed procedure for concluding the case.
2048 *Leptinotarsa* Chevrolat, 1837 (Insecta, Coleoptera): revised proposals for conservation.

R. V. Melville, *Secretary*
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ZOOLOGICAL NOMENCLATURE

ITZN 59 30 June 1980

The following Opinions and Direction No. 108 have been published recently by the International Commission on Zoological Nomenclature in the *Bull. Zool. Nom.*, Volume 37, part 2, 19 June 1980.

Opinion No.
1155 (p. 89) *Saperda inornata* Say, 1824 (Insecta, Coleoptera): designation of a neotype by the use of the plenary powers.
1157 (p. 96) *Sphex viatica* [sic] Linnaeus, 1758 (Insecta, Hymenoptera): designation of lectotype.

The Commission regrets that it cannot supply separates of Opinions or Directions.

R. V. Melville, *Secretary*
% British Museum (Natural History), Cromwell Road,
London, SW7 5BD, United Kingdom

ZOOLOGICAL NOMENCLATURE

ITZN 59 16 May 1980

The following Opinions have been published recently by the International Commission on Zoological Nomenclature in the *Bull. Zool. Nom.,* Volume 37, part 1, 8 May 1980.

Opinion No.
1147 (p. 11) Status, for the purposes of the type fixations, of the remains of Chironomid Larvae (Insecta, Diptera) provided by Thienemann to Kieffer for the description of new species based on the adults reared from those larvae.
1148 (p. 27) Stabilisation of the generic name *Orchelimum* Audinet-Serville, 1838 and the specific name *Orchelimum vulgare* Harris, 1841 (Insecta, Coleoptera) by use of the plenary powers.

The Commission regrets that it cannot supply separates of Opinions.

Please note that there is an error in the printing of the ruling of 1147 in the *Bull. Zool. Nom.,* vol. 37:11. After the title and before (1) of the Ruling should be inserted:

"In the case of species of CHIRONOMIDAE established by Professor J. J. Kieffer from adults provided by Professor A. Thienemann:"

R. V. Melville, *Secretary*
% British Museum (Natural History), Cromwell Road,
London, SW7 5BD, United Kingdom.

PAN-PACIFIC ENTOMOLOGIST
October 1980, Vol. 56, No. 4, pp. 335–340

PACIFIC COAST ENTOMOLOGICAL SOCIETY

PROCEEDINGS

THREE HUNDRED AND NINTIETH MEETING

The 390th meeting was held 19 January 1979, at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 23 members and 10 guests present.

The minutes of the meeting held 17 November 1978 were summarized. The following persons were elected to membership in the Society as regular members; Mrs. Roberta Brett and Dr. Theodore Kohn.

Dr. Schlinger reported on the death of Dr. Robert Van Den Bosch. Dr. Edward L. Smith kept the Society up to date on morphological studies with a discussion of the position of the compound eye in insects and related arthropods. Dee Wilder discussed the biology of the uncommon empidid fly *Niphogenia eucera* Melander, a terrestrial species in the mostly riparian subfamily Clinocerinae.

The main speaker of the evening was Dr. Evert I. Schlinger, Department of Entomology, University of California, Berkeley. His illustrated discussion of "An entomologist's view of down under," was well received.

Refreshments including home made cookies from Charles Dailey were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

THREE HUNDRED AND NINETY-FIRST MEETING

The 391st meeting was held 16 February 1979 at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and over one-hundred persons in attendance.

Minutes of the meeting held 19 January 1979 were summarized. The following persons were elected to membership in the Society, regular members; David M. Katz, Charles E. Kennett, Donald G. Manley, Laurel R. Fox and Richard L. Hurley; student members, John D. McLaughlin and Larry D. French.

The main speaker of the evening was Dr. William Jordan, whose film on insect biology entitled "Insects: Secrets of an Alien World," was enjoyed by all.

Refreshments were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

THREE HUNDRED AND NINETY-SECOND MEETING

The 392nd meeting was held 16 March 1979 at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 25 members and 5 guests present.

The minutes of the meeting held 16 February 1979 were summarized. The following persons were elected to membership in the Society, Gary Shook and Conrad Bravo.

Dave Kavanaugh introduced Dr. Morgan, a visiting professor studying coleoptera subfossils in Alaska. He also reported on the death of Carl Lindroth, noted carabid taxonomist. Frank Ennik discussed the dilemma of a proposed cut of 60% of the staff of the Vector Biology and Control Section of the California Department of Health Services. Dr. Arnaud gave the following note: Annette Frances Braun (1884–1978). Dr. Annette Frances Braun, a recognized authority on North American Microlepidoptera, died on November 27, 1978, in her 94th year, at Cincinnati, Ohio. Dr. Braun, a member of the Pacific Coast Entomological Society for at least 54 years (since our Society records show payment for the Pan-Pacific Entomologist with the beginning volume of this journal in 1924), was born on August 28, 1884, at Cincinnati, and received her M.A. (1908) and Ph.D. (1911) degrees from the University of Cincinnati. Dr. Braun's collections, including types, were presented to the Academy of Natural Sciences at Philadelphia within the last few years. It has been announced in the News of the Lepidopterists' Society that a complete obituary will be published on Dr. Braun in a forthcoming issue of the Journal of the Lepidopterists' Society.

The main speaker of the evening was Dr. Vincent Resh, Department of Entomology, University of California, Berkeley. He presented an illustrated program entitled "Caddisflies, Sponges, and Geothermal Energy: Hot-tubbing with the Trichoptera."

Refreshments were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

THREE HUNDRED AND NINETY-THIRD MEETING

The 393rd meeting was held 27 April 1979 at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 23 members and 14 guests present.

The minutes of the meeting held 16 March 1979 were summarized. The following persons were elected to membership in the Society, regular member; Dr. Vincent H. Resh; student members; Rex B. Dufour and Bill MacLachlan.

Dr. Arnaud read the following announcement: Museo Ecuatoriano de Ciencias Naturales.—Mrs. Nadia Venedictoff has requested that the founding of the Museum of Natural Sciences of Ecuador be announced. It is to be officially called the Museo Ecuatoriano de Ciencias Naturales. Correspondence in Spanish may be addressed to the Director: Ing. Miguel Moreno Espinosa, Calle Cordero, 1452, Quito, Ecuador. International correspondents may address correspondence to the Officer of International Relations (Oficial de Relaciones Exteriores): Señora Nadia Venedictoff, Castilla 6090, Quito, Ecuador. Correspondents may write, in order of preference, in French, Spanish, English, or Russian. They are requesting the contribution of separates, reprints, or any literature dealing with the natural sciences which applies to the American Tropics, especially if these deal in any way with the Ecuadorian flora or fauna.—Herman G. Real, Department of Entomology, University of California, Berkeley, 94720.

Dr. Edwards reported for Neil Wright about a collection of the rare leaf beetle *Timarcha* in the Fort Bragg area of California. Dr. Ross showed slides of mating insects from around the world to ready us for spring. Rosser Garrison discussed finding a small population of the damselfly *Ischnura gemina* (Kennedy) in San Francisco. *The First San Francisco, California Records of Glaucopsyche lygdamus incognitus Tilden (Lepidoptera:Lycaenidae). Glaucopsyche lygdamus* (Doubleday) is a common, widespread, polytypic lycaenid butterfly. In the San Francisco Bay Area of California it is represented by the subspecies *G. l. incognitus* Tilden (formerly known as *G. l. behrii* (Edwards)). Despite its occurrence throughout most of the San Francisco Bay Area, *G. l. incognitus* has not been reported from San Francisco itself. Previous records cite only the closely related and now extinct *G. xerces* (Boisduval). On April 1, 1979 one male and one female *G. l. incognitus* were collected along the bottom of Glen Canyon Park. On the same day, Harriet Reinhard (Personal Communication) found *G. l. incognitus* at a second San Francisco locality, Bay View Park. The Glen Canyon locality is probably less than a mile from the closest former *G. xerces* habitat located on the seaward slopes of Twin Peaks. This suggests that *G. l. incognitus* has either invaded San Francisco after the extinction of *G. xerces* or that earlier workers confused the two species.—John E. Hafernik, Jr., San Francisco State University.

THREE HUNDRED AND NINETY-FOURTH MEETING

The annual picnic was held 12 May 1979 at Del Vall Regional Park.

THREE HUNDRED AND NINETY-FIFTH MEETING

The 395th meeting was held 19 October 1979 at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 32 members and 37 guests present.

The minutes of the meeting held 27 April 1979 and the Annual Picnic of 12 May 1979 were summarized. The following persons were elected to membership in the Society, regular members; Panayotis Katsoyannos, Ron Russo, Lester E. Ehler, and Meldon A. Embury; student members; Timothy L. Tyler, John D. Beggs, Pauline Hnatow, Craig Holdren, and Christopher D. Nagano.

Alan Kaplan introduced Mel Thompson, of the American Arachnological Society, and Cliff Kitayama introduced Dr. Katsoyannos, visiting professor from Greece. Dee Wilder discussed some cave insects from Coppermine Gulch, and Dr. Ross showed slides of the curved front tarsi of a megachilid bee which he suggested could be used to cover the female's eyes during mating.

First records of 2 species of horse flies (Tabanus) *in Baja California Sur.*—The following records of Tabanidae in Baja California Sur (a pair of each species is passed among the audience) are unusual for several reasons: The 2 species of *Tabanus* are previously unrecorded from Baja California, one of which is otherwise widespread in mainland Mexico. Though no corresponding, biting females of either species have been recorded from this peninsula, among insects recently curated at the Academy were a single male each of the 2 species taken incidental to general collecting of Orthoptera by D. B. Weissman and D. Lightfoot, both specialists in that order of insects. It is not surprising that neither recalls the circumstances of capture, though black light had been much used for certain crepuscular crickets and might have attracted these 2 males from adjacent resting places. Both species belong in the widely colonizing subgroup of *Neotabanus,* the lined horse flies, a species of which is the only one that is established and isolated on the Galapagos Islands. Both males carry the same data on the collection labels: Baja California Sur. 0.5 km N Km 8 N. La Paz on Mex (hwy) 1, 16-VII-1978.

Tabanus subsimilis Bellardi, one male. This is the typical form with upper area of enlarged facets much expanded and with minute hairs, but body colors brighter, not faded as in the desert form, ssp. *nippontucki* Philip.

The species on mainland Mexico has been seen mostly as females, from most states from Nuevo Léon to Sonora south to Chiapas. I had earlier described this species from southeastern United States as *T. schwardti* before discovering, on visit to Bellardi's collection in Turin, Italy, that he had already named it *subsimilis* in Mexico.

Tabanus commixtus Walker, one male. This has the characteristic bare, small faceted eyes. This is a more surprising record for Baja California, since the sparse records for the females in southern mainland Mexico are not previously known north of Sinaloa on the west coast of Mexico.

I am indebted to Dr. G. B. Fairchild of the University of Florida for identification of these 2 male *Tabanus.*—Cornelius B. Philip, California Academy of Sciences, San Francisco.

The main speaker of the evening was Dr. Stan Williams, Professor of Biology, San Francisco State University. His presentation entitled "Biology of Scorpions," was informative and well illustrated.

Refreshments were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

THREE HUNDRED AND NINETY-SIXTH MEETING

The 396th meeting was held 16 November 1979 at 8:00 p.m. in the Morrison Auditorium of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 31 members and 23 guests present.

Minutes of the meeting held 19 October 1979 were summarized. Ed Rodgers was elected to membership in the Society as a student member.

President Doyen designated the nominating committee as Drs. Grigarick, Thorp and Hagen. Students were introduced from Sonoma State, Hayward State and Sierra College. Dr. E. L. Smith showed drawings of the mouthparts of ancient insects and discussed similarities with those of today.

The main speaker of the evening was Dr. David H. Kavanaugh, Department of Entomology, California Academy of Sciences. His discussion of Lituya Bay: a glacial refugium, was interesting and well illustrated with slides from a recent expedition there.

Refreshments including home made cookies from Esther Ulrich were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

THREE HUNDRED AND NINETY-SEVENTH MEETING

The 397th meeting was held 7 December 1979 at 8:00 p.m. in the Goethe room of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Doyen presiding and 30 members and 14 guests present.

The minutes of the meeting held 16 November were summarized. Dr. Ross reported for the auditing committee and Dr. Arnaud for the treasurer and said that the treasurer's office is indebted to Mrs. Vashti F. Getten (as volunteer) and Mrs. Gail Freihofer (Entomology Secretary) for their handling of the Society's accounts, billings, and mailing of publications, and to our member Mr. H. Vannoy Davis of Walnut Creek, California, for his annual audit of the Treasurer's records and completion of the Society's tax forms. The nominating committee brought forth the following names for office in 1980: President-elect David H. Kavanaugh, Secretary Larry G. Bezark, and Treasurer Paul H. Arnaud, Jr.

The following person was elected to membership in the Society as a student member; Laura D. Merrill.

Kirby Brown discussed *Stenomorpha compressa* in the Fresno area. Jerry Powell showed slides of the Lepidopterists' Society meeting held in Fairbanks, Alaska. Dee Wilder showed slides of the dolichopodid *Polymedon* from the Eel River. Edward L. Smith reported on insect palpi and genitalia, in reference to their origins. John Hafernik talked about mating behavior of skippers.

The gavel was turned over to the new president, Marius Wasbauer, who introduced Dr. John Doyen and the presidential address entitled "The darkling ground beetles—some aspects of the biology and classification of the Tenebrionidae."

Refreshments were served in the Goethe Room following the meeting.—L. G. Bezark, Secretary.

Marius Wasbauer	Dave Kavanaugh	R. E. Somerby	Paul Arnaud, Jr.
President	*President-elect*	*Secretary*	*Treasurer*

THREE HUNDRED AND NINETY-EIGHTH MEETING

The 398th meeting was held on Friday, 18 January 1980 at 8:00 p.m. in the Goethe Room of the California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. Thirty-four members and sixteen guests were present.

Minutes of the meeting held 7 December 1979 were summarized. Dean Gooch and James A. Steele were elected to student membership.

Robert Langston gave a note on the activity of Lepidoptera in central Alaska. In seven days, examples were taken in nine families. Areas collected were 108 miles NE of Fairbanks, University of Alaska, Fairbanks, Nenana, east of Mt. McKinley Park and Denali Highway.

Charles Griswold reported on a general collecting trip to Sierra Laguna in Baja California Sur with John Doyen, Walter Tschinkel, Marius Wasbauer, and Paul Rude. The general vegetation included Madrone, oaks and pine. The plants were going into the dry season. Plecoptera, Trichoptera and Ephemeroptera were taken for the first time in this area.

John Hafernick reported on a desert field trip. He reported on the biology of flower meloid beetles with tubular mouth parts. The life cycle was discussed mentioning anthophorid bees with many triungulins.

Dr. Marius Wasbauer introduced Dr. Paul Tuskes who presented an interesting talk entitled "Population Dynamics and Physiological Changes in Overwintering Populations of the Monarch Butterfly." An informative discussion continued after the talk.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

THREE HUNDRED AND NINETY-NINTH MEETING

The 399th meeting was held on Friday, 15 February 1980, at 8:00 p.m., in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of 38 persons were present of which 22 signed as members and six as guests.

Minutes of the meeting held 18 January 1980 were summarized. Mr. Kevin N. Barber of Ontario, Canada became a student member and Mr. W. Anthony Doolin a regular member.

Ed Smith brought to our attention a large illustration of a mysterious insect showing details of the head capsule and mouth parts. He revealed later that it represented a predaceous mayfly from Australia.

Dr. Marius Wasbauer introduced Dr. Lynn S. Kimsey who presented an illustrated talk entitled "The Functional Morphology and Evolution of Orchid Bees and Cuckoo Wasps." The flight, feeding and behavior of both groups were related to the evolutionary development of their morphology.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDREDTH MEETING

The 400th meeting was held on Friday, 14 March 1980, at 8:00 p.m. in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of 24 persons were present of which 20 signed as members and 4 as guests.

Minutes of the meeting held 15 February 1980 were summarized. Dr. J. V. Mankins of Siguatepeque, Honduras and Mr. T. W. Bowen of the Environmental Laboratory, Hunterville, North Carolina became regular members.

Robert L. Langston gave a note on seasonal and laboratory conditions, as they affect the phenotype of the Buckeye Butterfly *Precis coenia* (Hubner). He brought a collection of such variants that showed; an increase in the size of the eye-spots; an increase of blue colors; and the appearance of blue-green ground color, to name a few variants.

Charles Dailey brought to our attention a new book entitled "Galls in California" by Ron Russo. It was published by Boxwood Press and is available at the Academy Book Store; Lucas

Book Store in Berkeley. The book pictures galls and the causative agents, including fungi, bacteria and insects.

Robert Wharton showed a series of slides depicting the ovipositional behavior of an undescribed species of *Halterorchis*, a Mydas fly of the Namib Desert. The adult female buried her abdomen to a depth that almost entirely covered her wings.

Dr. Marius Wasbauer introduced Dr. John H. Perkins who presented an illustrated talk entitled "Crisis and Change in Economic Entomology 1945–1980." The presentation was provocative for many, if not all present. Dr. Perkins clearly outlined the genesis of three scientific paradigms, each of which was woven from the respective historic time, scientific group, and institutional association. He tied the views represented by each paradigm to individuals who formed like-minded groups. Each group was apparently influenced by the constraints and organizational parameters of the institutions to which they belonged, and to their immediate entomological world. The three paradigms were respectively:

1. Chemical Pest Management.
2. Integrated Management.
3. Total Pest Management.

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

FOUR HUNDRED AND FIRST MEETING

The 401st meeting was held on Friday, 18 April 1980, at 8:00 p.m. in the Morrison Auditorium, California Academy of Sciences, Golden Gate Park, San Francisco, with President Wasbauer presiding. A total of 37 persons were present of which 27 signed as members, and 10 as guests.

Minutes of the meeting held 14 March 1980 were summarized. Dr. Wasbauer discussed dropping the annual picnic because of poor attendance.

Two notes were given. Dr. Eichlin presented some slides on the damage to junipers in San Diego County by the introduced pest *Stenolechia bathrodyas* Meyr. (Gelechiidae). He also discussed the presence in Sacramento County of a heretofore Eastern clearwing moth *Podosesia syringae* (Harris). Dr. Kavanaugh discussed the distribution of Amphizoidae. There are five species, of which four occur in North America. Two were reported from the Old World, but *kasmerensis* of India was determined to be a Dytiscidae. The remaining species is presumed to be in the Paris Museum, but has not been seen.

Dr. Marius Wasbauer introduced Dr. Robert Wharton, formerly a Research Associate with the Namib Research Institute who presented an illustrated talk entitled "Biology of selected Namib Desert Invertebrates with emphasis on the Tenebrionidae."

Refreshments were served in the Goethe Room following the meeting.—R. E. Somerby, Secretary.

PACIFIC COAST ENTOMOLOGICAL SOCIETY

STATEMENT OF INCOME, EXPENDITURES AND CHANGES IN FUND BALANCES

Years Ended September 30, 1979 and 1978

	1979	1978
Income		
Dues and subscriptions	$ 8,737	$ 8,432
Reprints and miscellaneous	5,847	7,615
Sales of Memoirs	171	375
Interest on savings accounts	1,692	872
Dividends, American Telephone & Telegraph Co.	292	352
Decrease in value of capital stock of American Telephone & Telegraph Co.	(570)	(90)
	16,169	17,556
Expenditures		
Publication costs—Pan-Pacific Entomologist	10,972	9,405
Reprints, postage and miscellaneous	4,024	2,928
	14,996	12,333
Increase in fund balances	1,173	5,223
Fund balances October 1, 1978 and 1977	33,143	27,920
Fund balances September 30, 1979 and 1978	$34,316	$33,143

STATEMENT OF ASSETS

September 30, 1979 and 1978

	1979	1978
Cash in bank		
Commercial account	$ 390	$ 668
Savings accounts		
General fund	12,374	11,015
Memoir, Fall funds	13,911	13,491
Life membership fund	3,241	2,999
Total cash in bank	29,916	28,173
Investment in 80 shares of American Telephone & Telegraph Co. common stock (Life Membership and Fall Funds), at market value	4,400	4,970
	$34,316	$33,143

See accompanying notes to the financial statements.

PACIFIC COAST ENTOMOLOGICAL SOCIETY

NOTES TO THE FINANCIAL STATEMENTS

Year Ended September 30, 1979

SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Accounting Method

Income, expenditures and assets are recorded on the cash basis of accounting.

Marketable Securities

American Telephone & Telegraph Co. common stock is carried at market value. Increases and decreases in value are reflected in income.

Income Tax

The Society is exempt from Federal income and California franchise tax.

Accounts Receivable

As of September 30, 1979 accounts receivable aggregated $552 as follows:

September, 1979 billings	$210
Prior billings	312
	$522

Accounts Payable

As of September 30, 1979 unpaid bills aggregated $721.

As Chairman of the Auditing Committee, and in accordance with its by laws, I have reviewed the financial records of the Society.

During the course of this review nothing was noted which indicated any material inaccuracy in the foregoing statements.

H. Vannoy Davis
Chairman of the Auditing Committee

THE PAN-PACIFIC ENTOMOLOGIST

INDEX TO VOLUME 56

Published by the

Pacific Coast Entomological Society

in cooperation with

The California Academy of Sciences

VOLUME FIFTY-SIX

1980

San Francisco, California
1980

CONTENTS FOR VOLUME 56

THE PAN-PACIFIC ENTOMOLOGIST
Information for Contributors

Papers on the systematic and biological phases of entomology are favored, including short notes or articles up to *ten* printed pages, on insect taxonomy, morphology, ecology, behavior, life history, and distribution. Excess pagination must be approved and *will* be charged to the author. Papers are published after acceptance in approximately the order that they are received. Papers of less than a printed page will be published as space is available, in **Scientific Notes.**

All manuscripts will be reviewed *before acceptance*.

Manuscripts for publication, proofs, and all editorial matters should be addressed to the editor.

General. — The metric system is to be used exclusively in manuscripts, except when citing label data on type material, or in direct quotations when cited as such. Equivalents in other systems may be placed in parentheses following the metric, *i.e.* "1370 m (4500 ft) elevation".

Typing. — **Two copies** of each manuscript must be submitted (original and one xerox copy or two xerox copies are suitable). All manuscripts must be **typewritten, double-spaced** throughout, with ample margins, and be on bond paper or an equivalent weight. **Carbon copies** or copies on paper larger than 8½ × 11 inches are not acceptable.

Underscore only where ***italics*** are intended in the body of the text. **Number all pages** consecutively and put authors name on each sheet. References to **footnotes** in text should be numbered consecutively. Footnotes **must** be typed on a separate sheet.

Manuscripts with extensive corrections or revisions will be returned to the author for retyping.

First Page. — The page preceding the text of the manuscript must include (1) the complete title, (2) the order and family in parentheses, (3) the author's name or names, (4) the institution with city and state or the author's home city and state if not affiliated (5) the complete name and address to which proof is to be sent.

Names and descriptions of organisms. — The first mention of a plant or animal should include the full scientific name with the author of a zoological name *not* abbreviated. Do not abbreviate generic names. Descriptions of taxa should be in telegraphic style. The International Code of Zoological Nomenclature must be followed.

Tables. — Tables are expensive and should be kept to a minimum. Each table should be prepared as a line drawing *or* typed on a separate page with heading at top and footnotes below. Number tables with Arabic numerals. Number footnotes consecutively for each table. Use only horizontal rules. Extensive use of tabular material requiring typesetting may result in increased charges to the author.

Illustrations. — No extra charge is made for line drawings or halftones. Submit only photographs on glossy paper and original drawings. Authors *must* plan their illustrations for reduction to the dimension of the printed page (117 × 181 mm; 4⅝ × 7⅛ inches). If possible, allowance should be made for the legend to be placed beneath the illustration. Photographs should not be less than the width of the printed page. Photographs should be mounted on stiff card stock, and bear the illustration number on the face.

Loose photographs or drawings which need mounting and/or numbering are not acceptable. Photographs to be placed together should be trimmed and abut when mounted. Drawings should be in India Ink, or equivalent, and at least twice as large as the printed illustration. Excessively large illustrations are awkward to handle and may be damaged in transit. It is recommended that a metric scale be placed on the drawing or the magnification of the *printed* illustration be stated in the legend where applicable. Arrange figures to use space efficiently. Lettering should reduce to no less than 1 mm. *On the back of each illustration* should be stated (1) the title of the paper, (2) the author's complete name and address, and (3) whether he wishes the illustration returned to him. Illustrations not specifically requested will be destroyed. **Improperly prepared illustrations will be returned to the author for correction prior to acceptance of the manuscript.**

Figure legends. — Legends should be typewritten double-spaced on separate pages headed EXPLANATION OF FIGURES and placed following LITERATURE CITED. Do not attach legends to illustrations.

References. — All citations in text, e.g., Essig (1926) or (Essig 1958), must be listed alphabetically under LITERATURE CITED in the following format:

Essig, E. O. 1926. A butterfly migration. Pan-Pac. Entomol., 2:211–212.
Essig, E. O. 1958. Insects and mites of western North America. Rev. ed. The Macmillan Co., New York, 1050 pp.

Abbreviations for titles of journals should follow the list of *Biological Abstracts*, 1966, 47(21):8585–8601. For **Scientific Notes** the citations to articles will appear within the text, i.e. . . . "Essig (1926, Pan-Pac. Entomol., 2:211–212) noted . . .".

Proofs, reprints, and abstracts. — Proofs and forms for the abstract and reprint order will be sent to authors. Major changes in proof will be charged to the author. Proof returned to the editor without the abstract will not be published.

Page charges. — All regular papers of one to ten printed pages are charged at the rate of $24.00 per page. Private investigators or authors without institutional or grant funds may apply to the society for a grant to cover a portion of the page charges. In no case will society grants subsidize more than two thirds of the cost of page charges. Individuals receiving a society subsidy thus will be billed a minimum of $8.00 per page. Pages additional to the first ten are charged at the rate of $30.00 per page, without subsidy. Page charges are in addition to the charge for reprints and do not include the possible charges for extra pagination or the costs for excessive changes after the manuscript has been sent to the printer.

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1st 100	18.25	3.00
Additional 100's	12.75	1.75

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